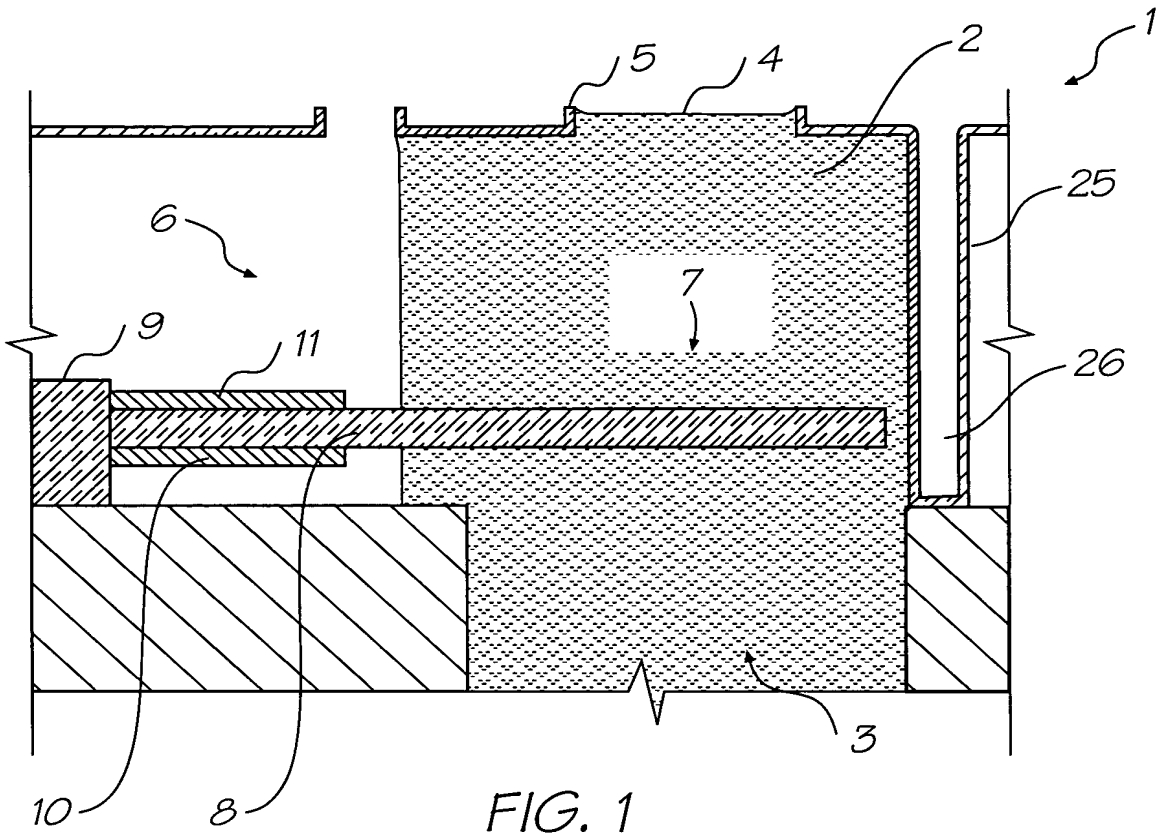


FIG. 1

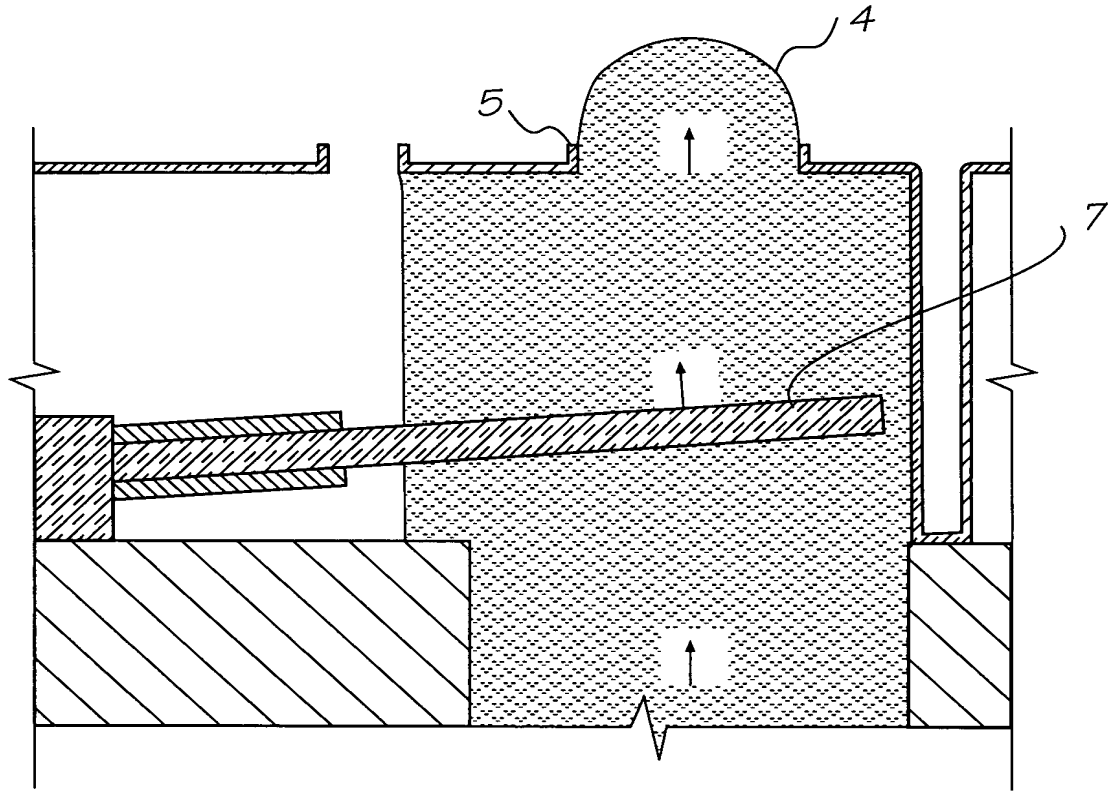


FIG. 2

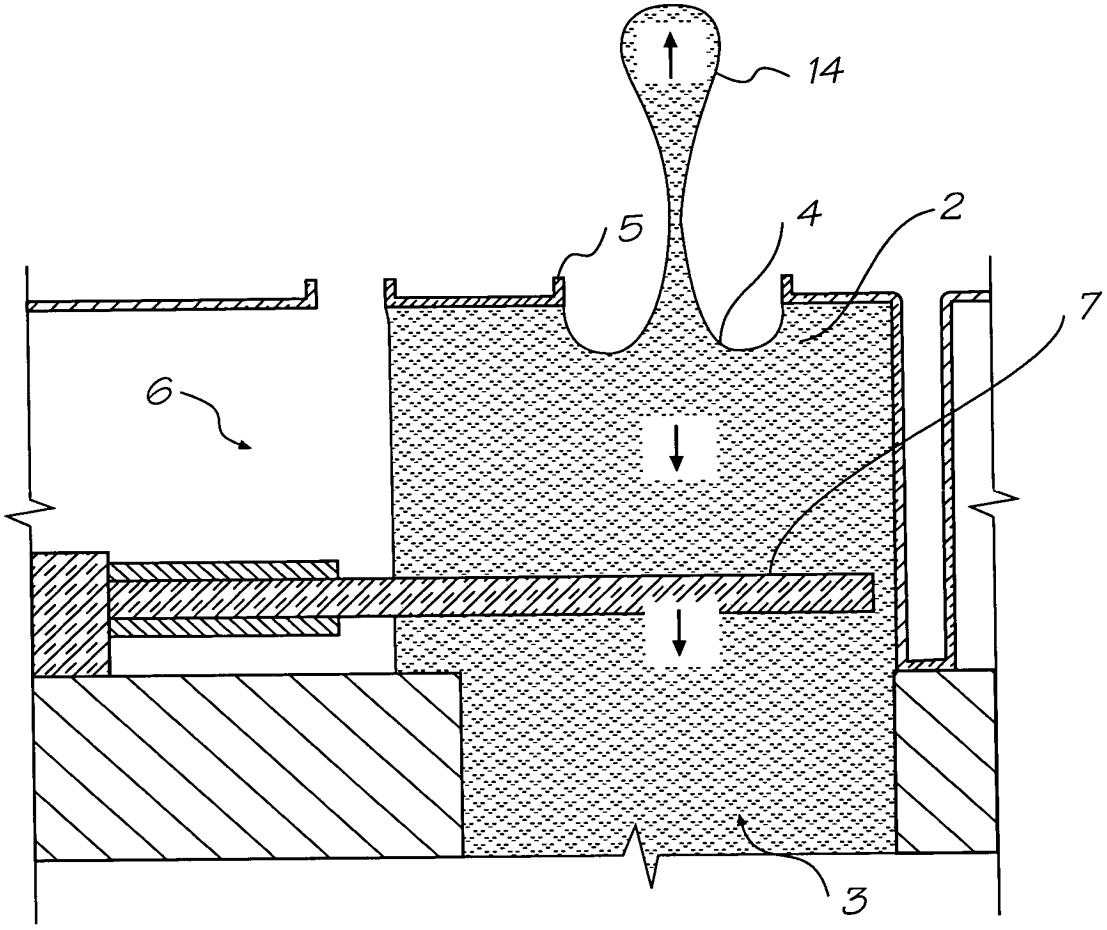


FIG. 3

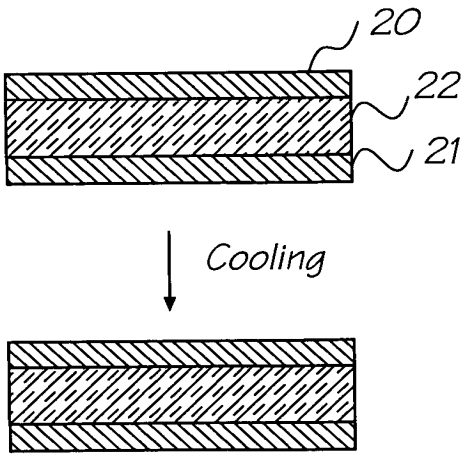


FIG. 4

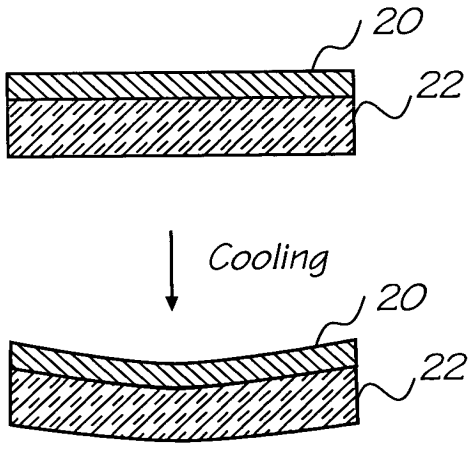


FIG. 5

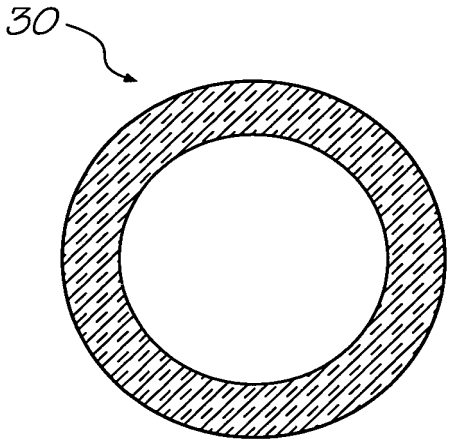


FIG. 6

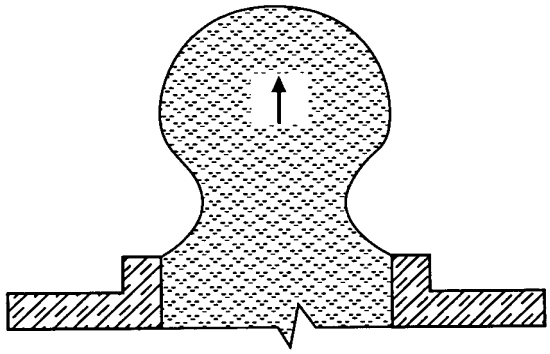


FIG. 7

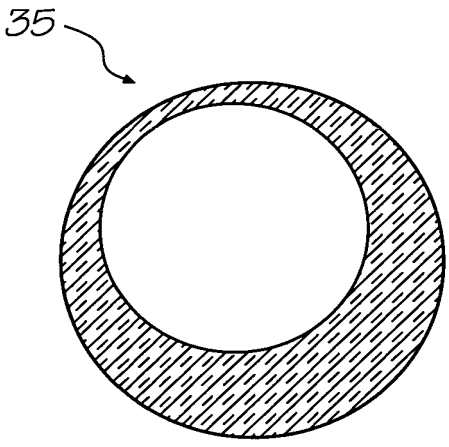


FIG. 8

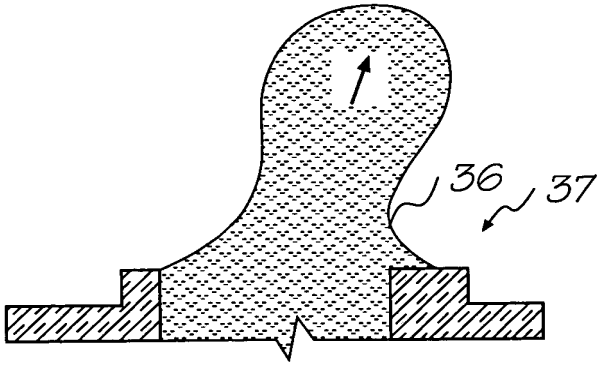


FIG. 9

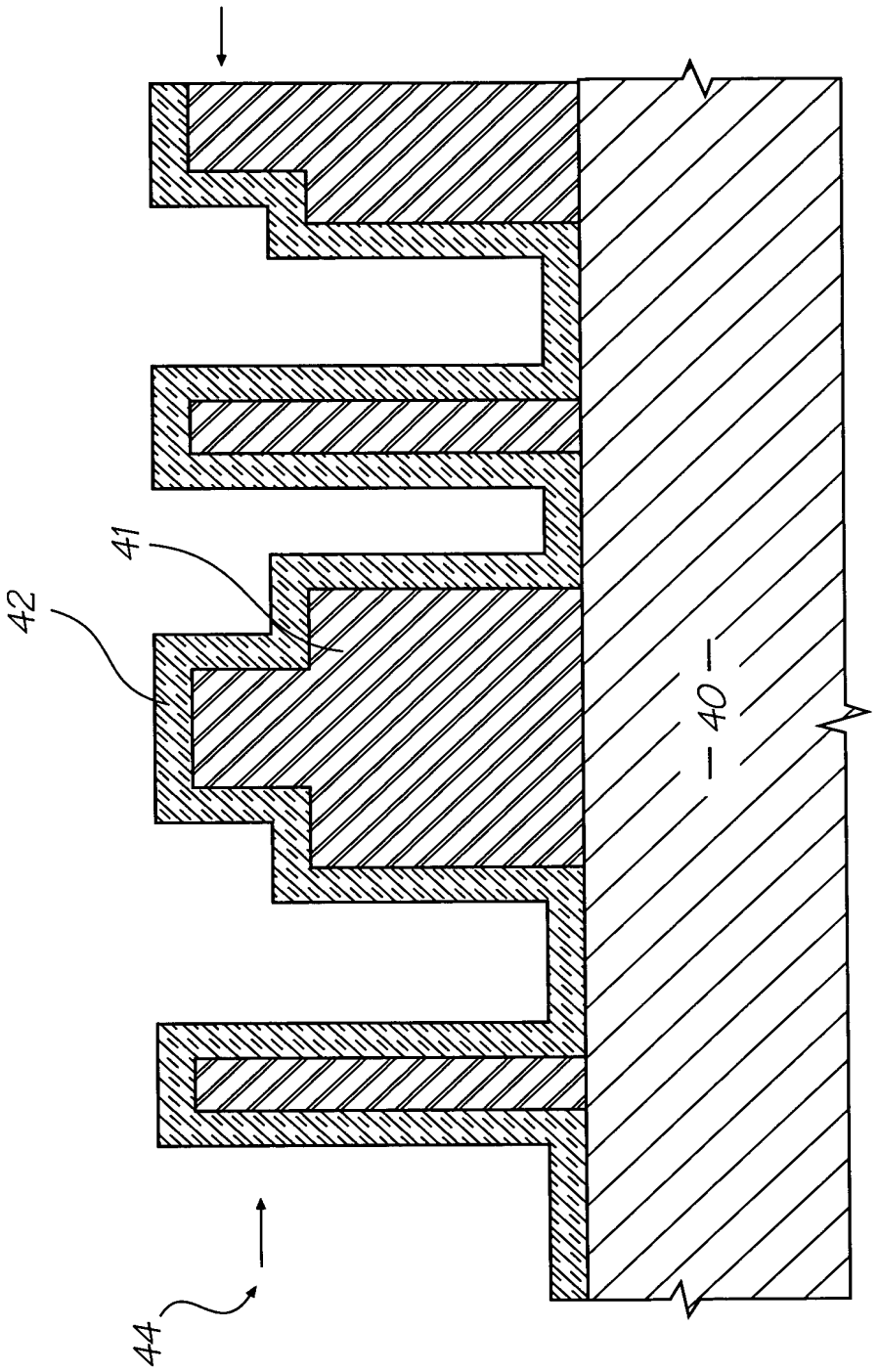


FIG. 10

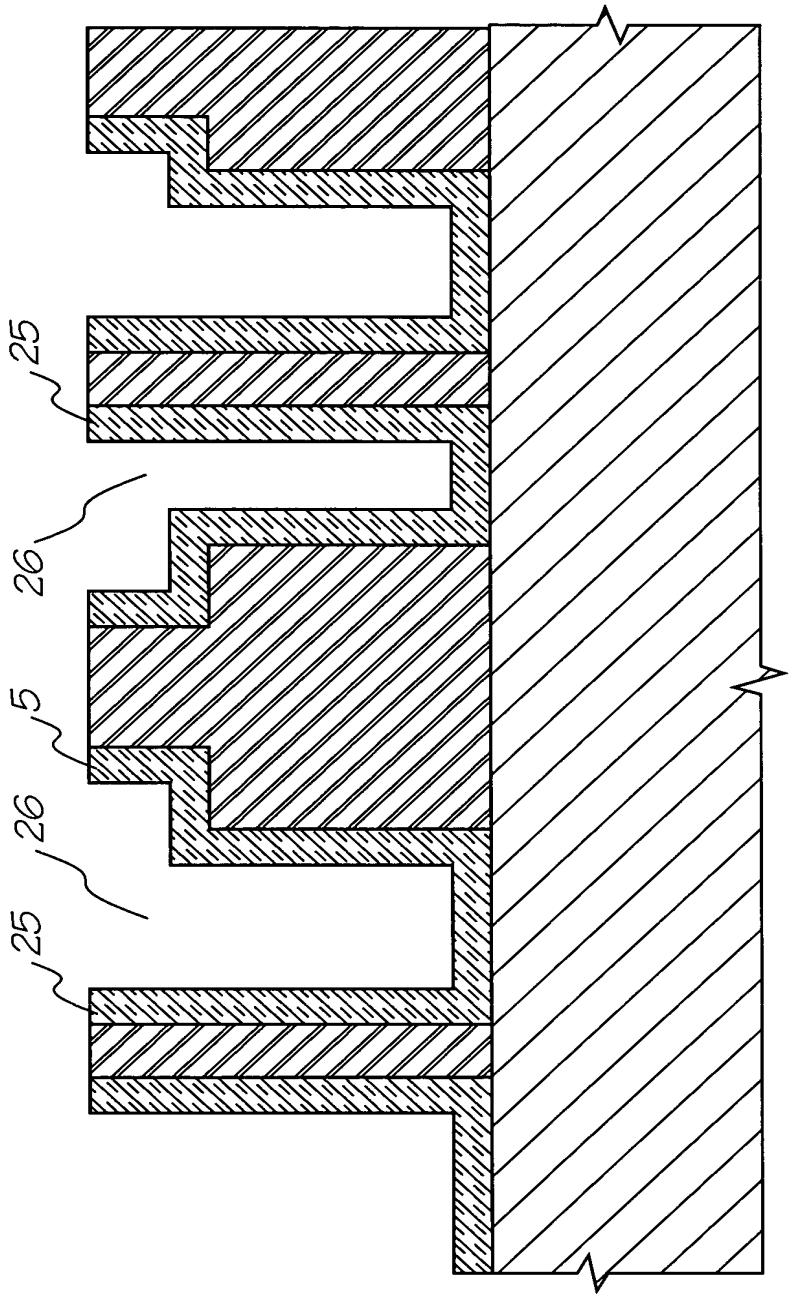


FIG. 11

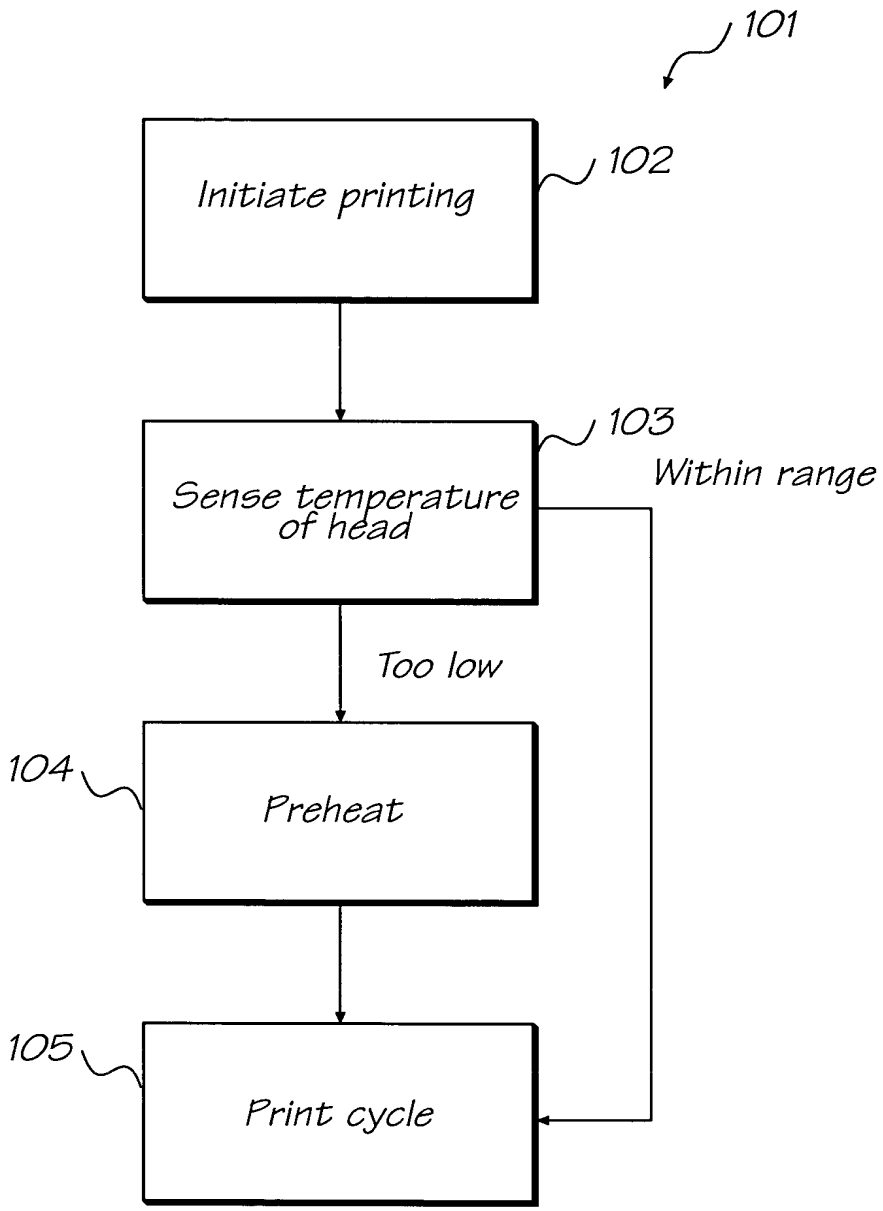

101
Initiate printing
102
Sense temperature of head
103
Within range
Too low
104
Preheat
105
Print cycle

FIG. 12

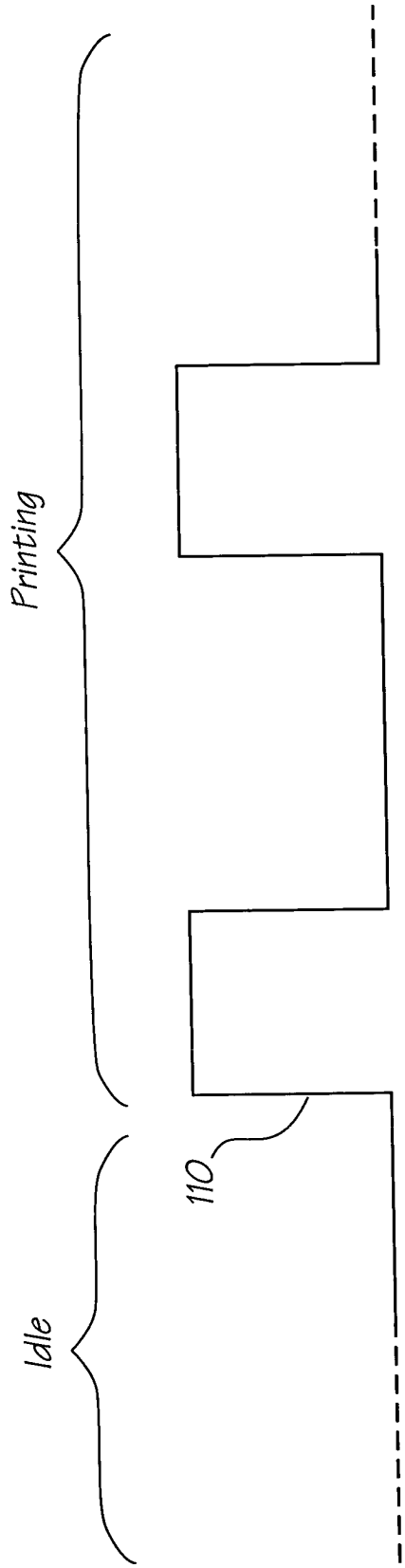


FIG. 13

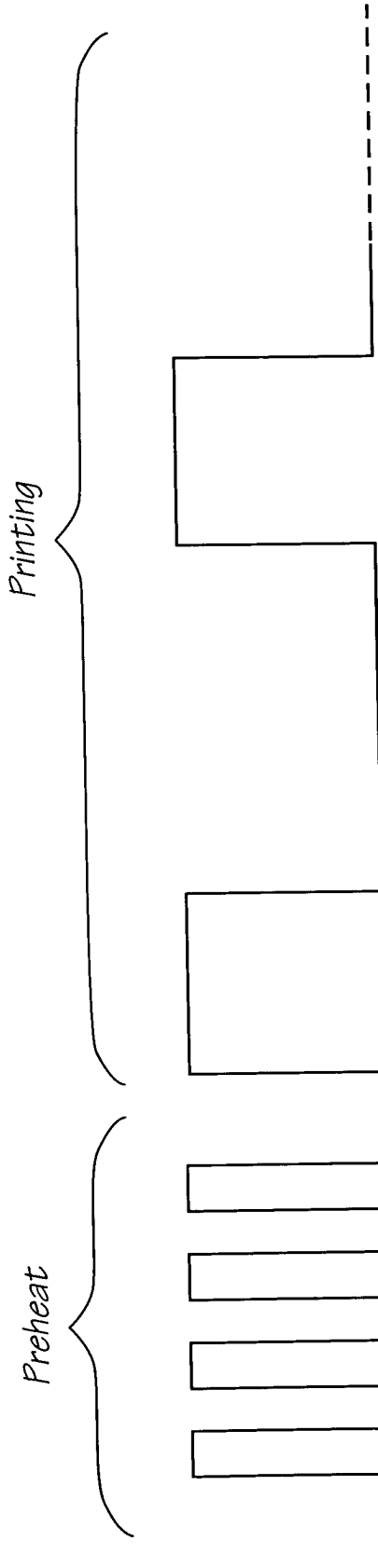


FIG. 14

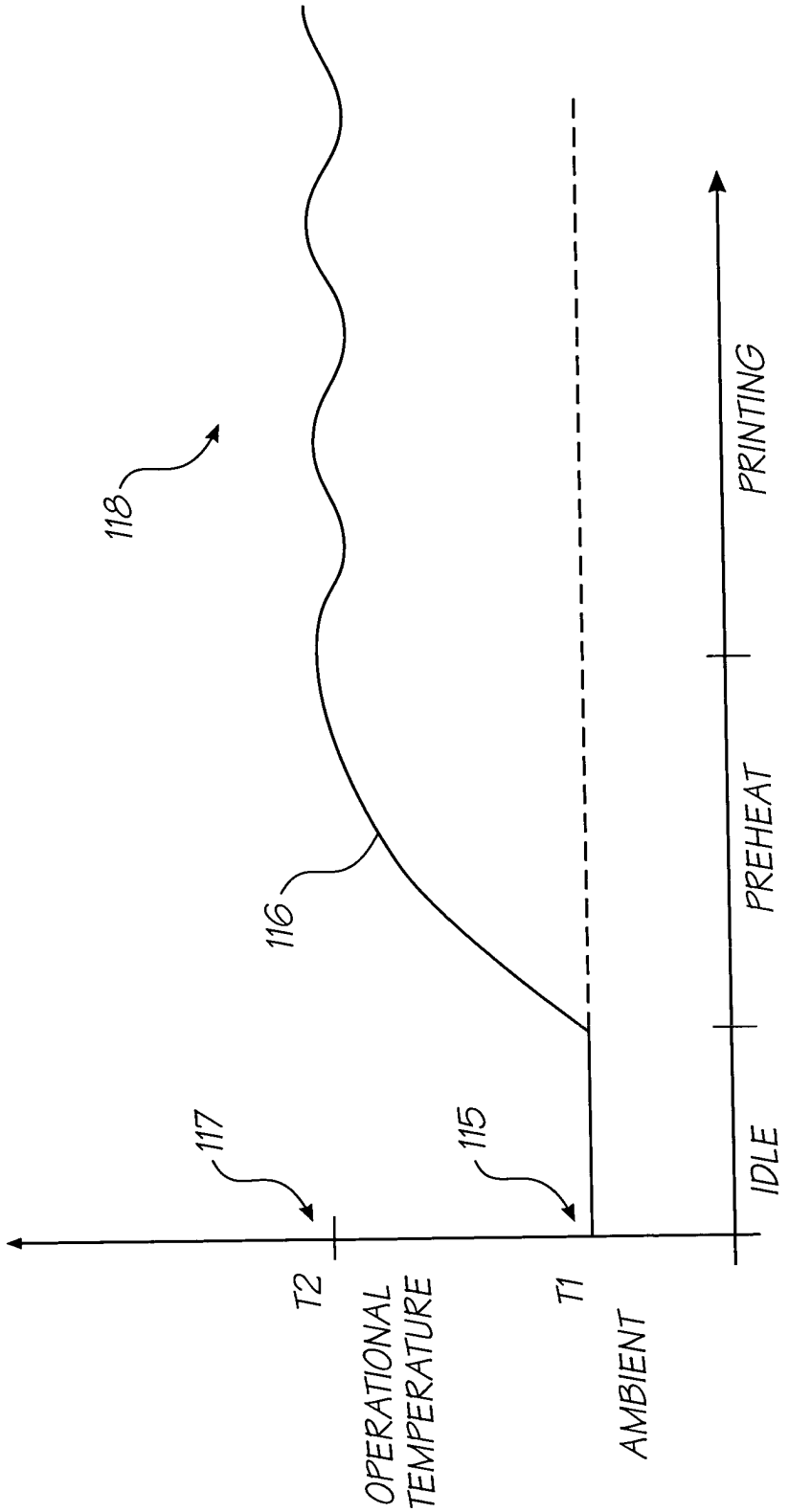

118
116
117
115
T2
T1
OPERATIONAL TEMPERATURE
AMBIENT
IDLE
PREHEAT
PRINTING

FIG. 15

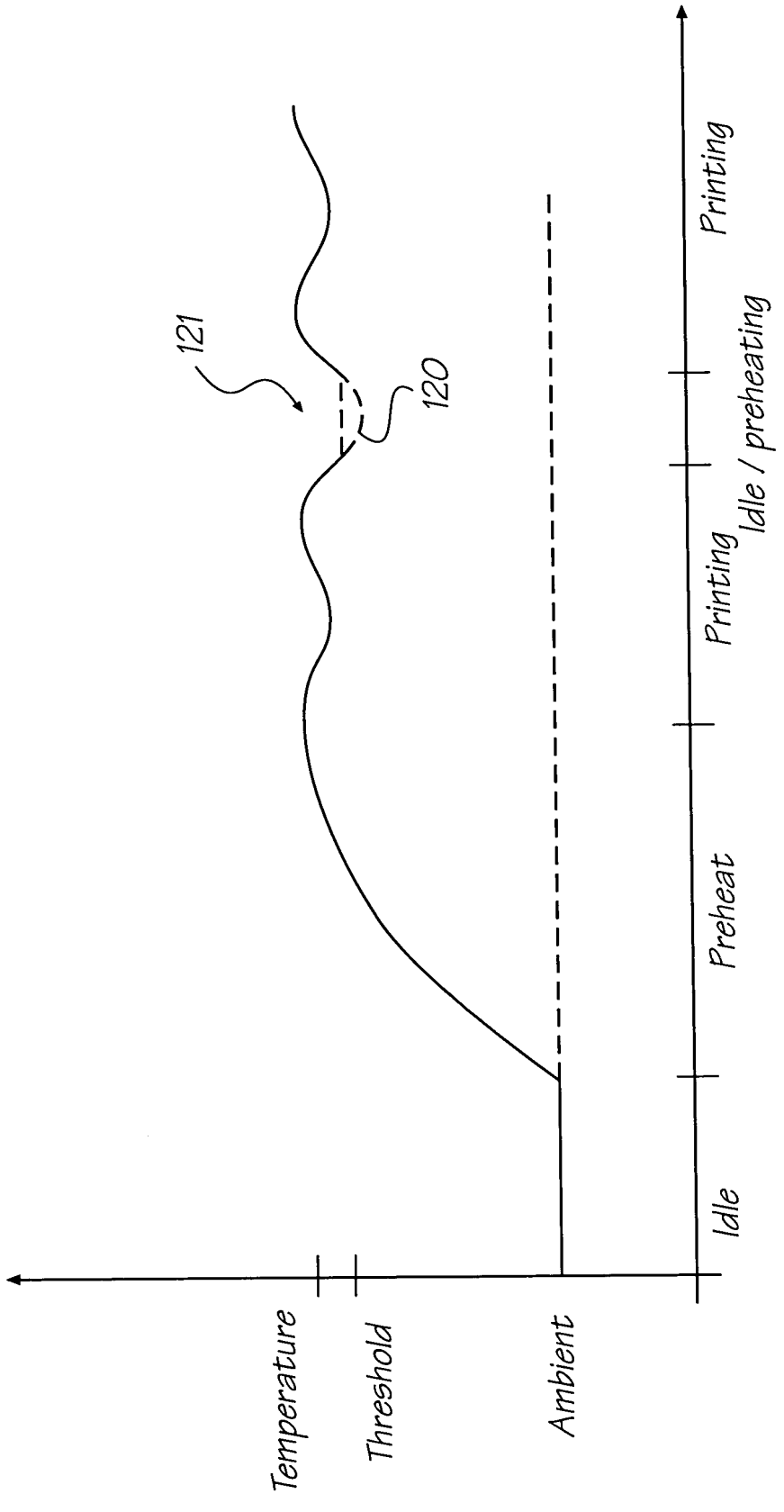

Temperature
Threshold
Ambient
Idle
Preheat
Printing
Idle / preheating
Printing
120
121

FIG. 16

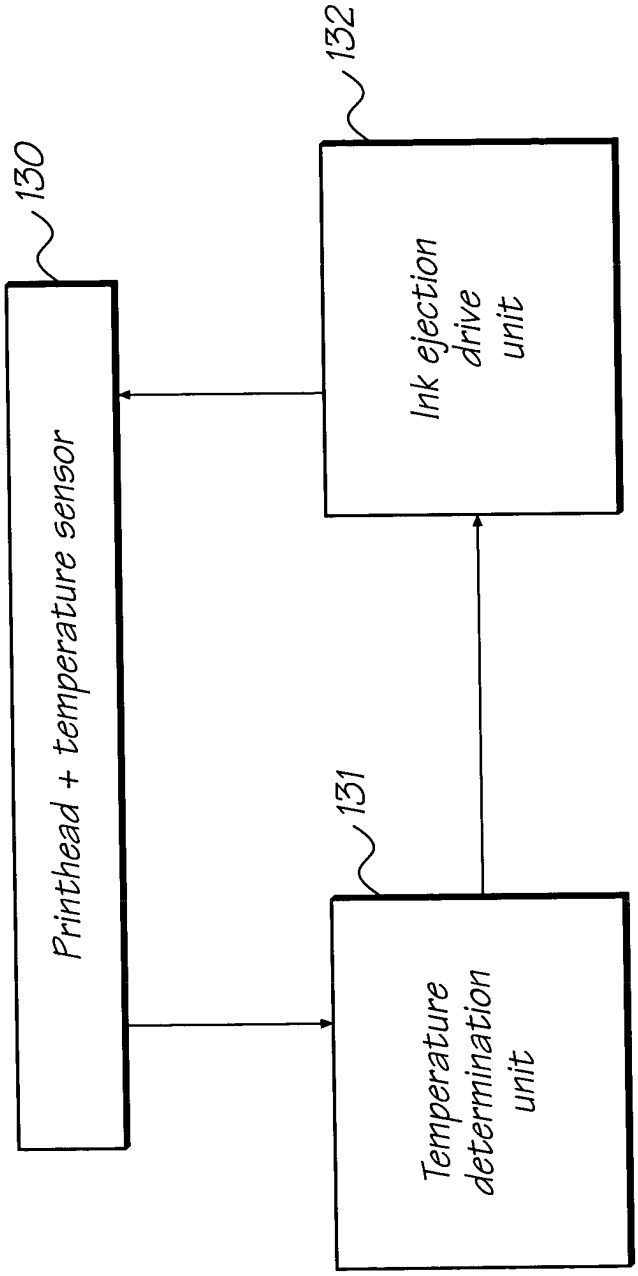

130
Printhead + temperature sensor
132
Ink ejection drive unit
131
Temperature determination unit

FIG. 17

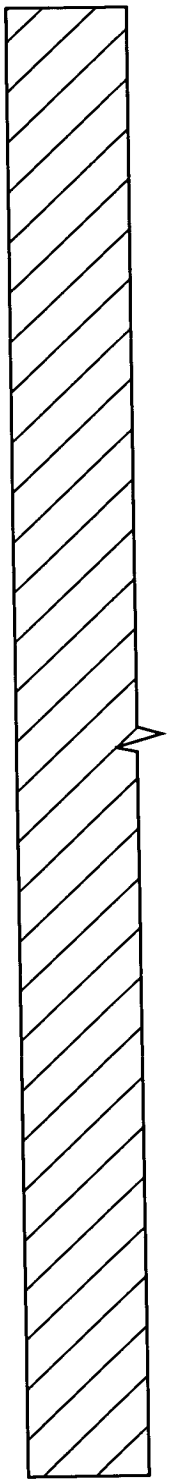
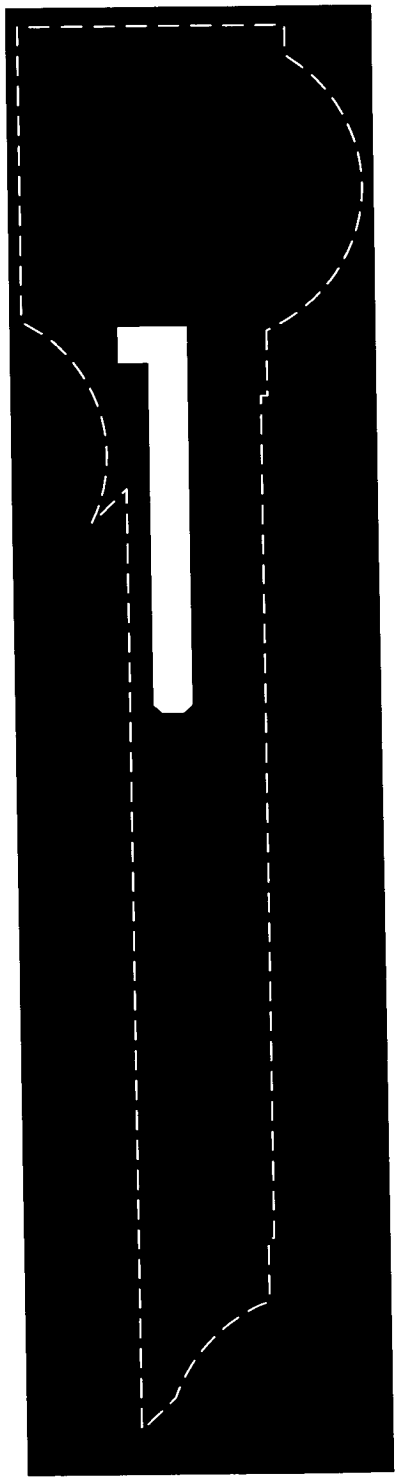
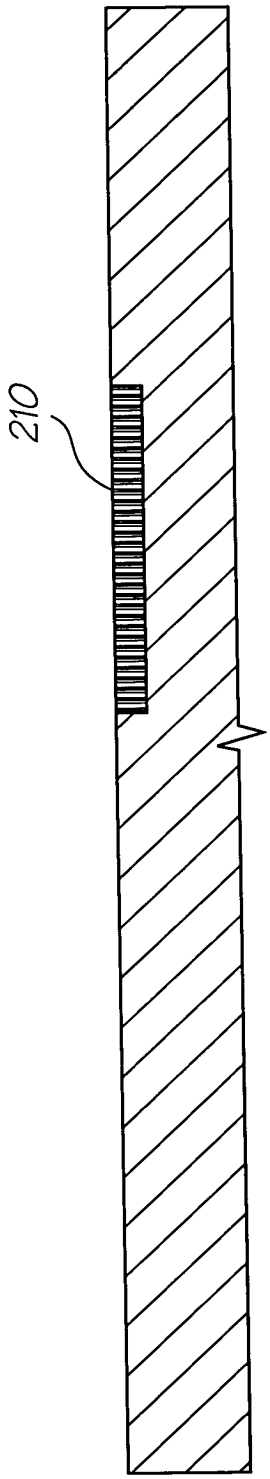


FIG. 18



N-Well mask

FIG. 19



Implant N-Well

FIG. 20

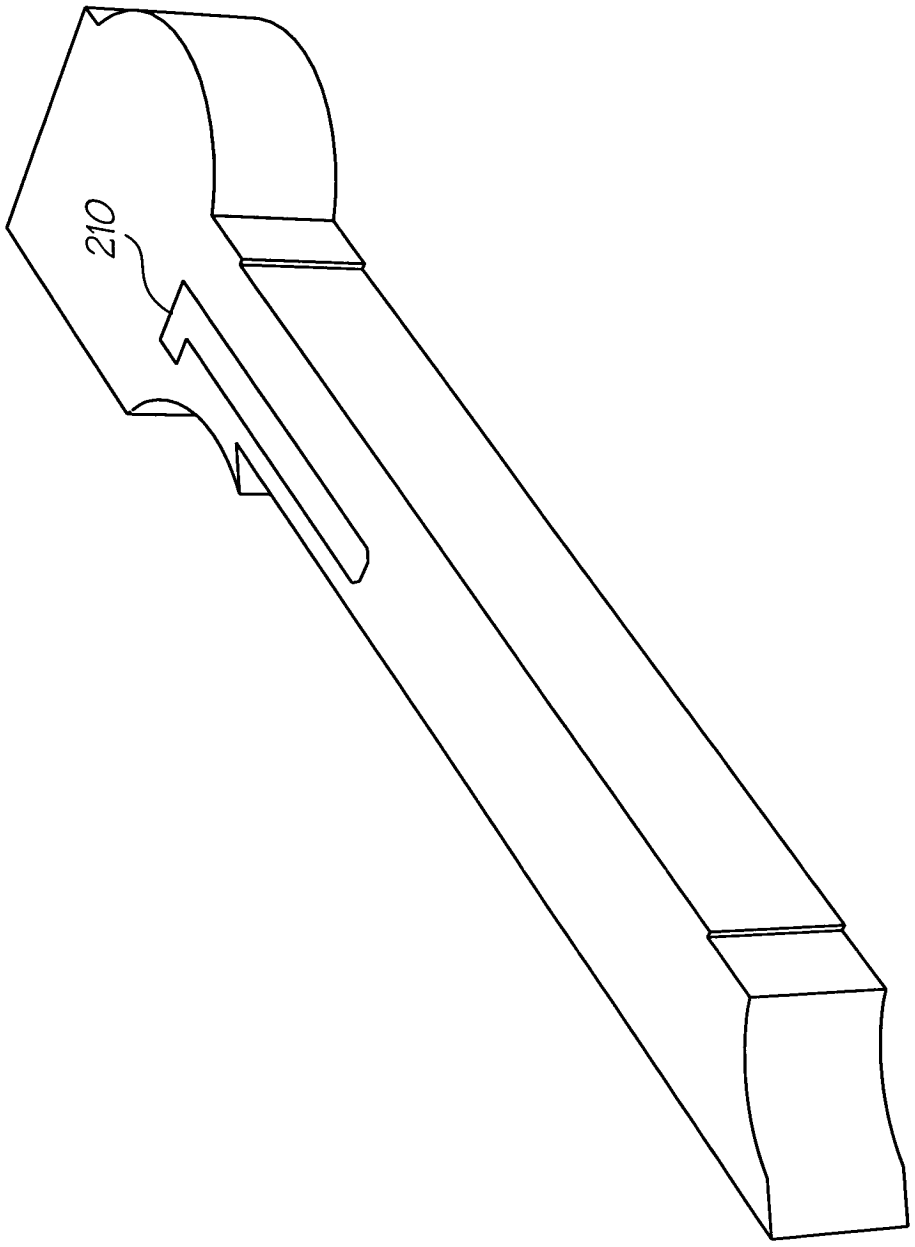


FIG. 21

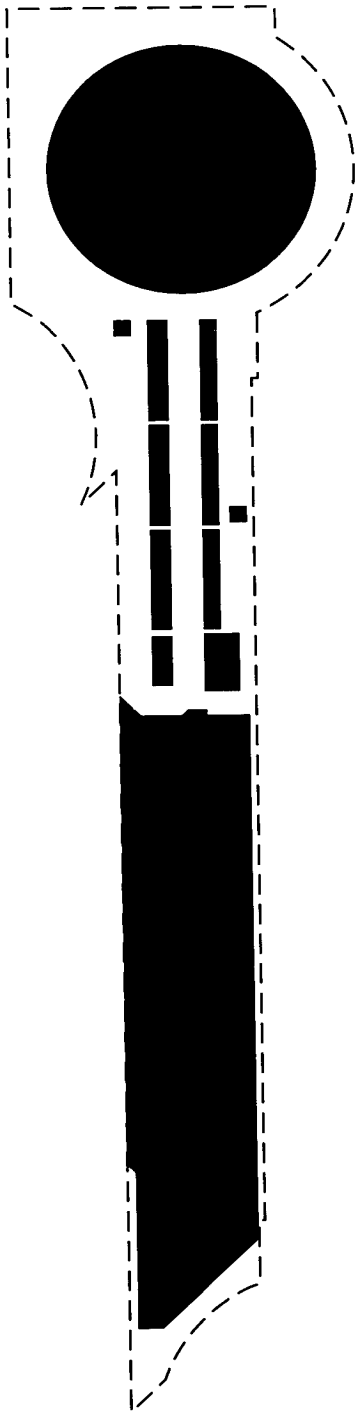


FIG. 22

Active mask

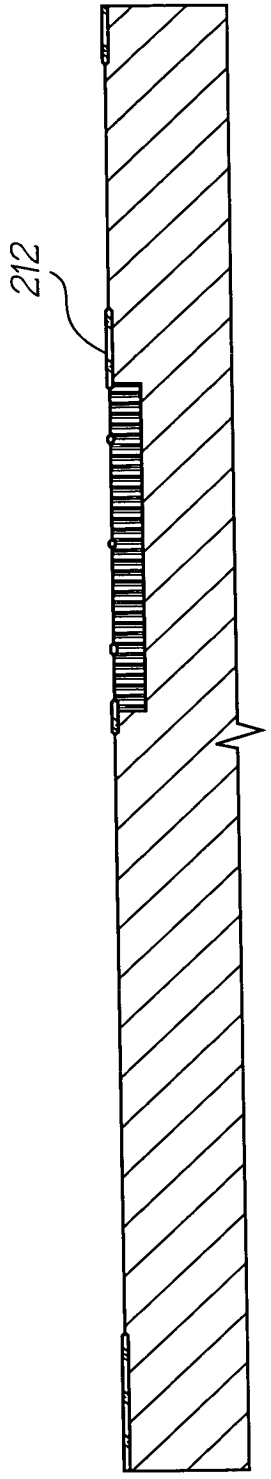


FIG. 23

Grow field oxide

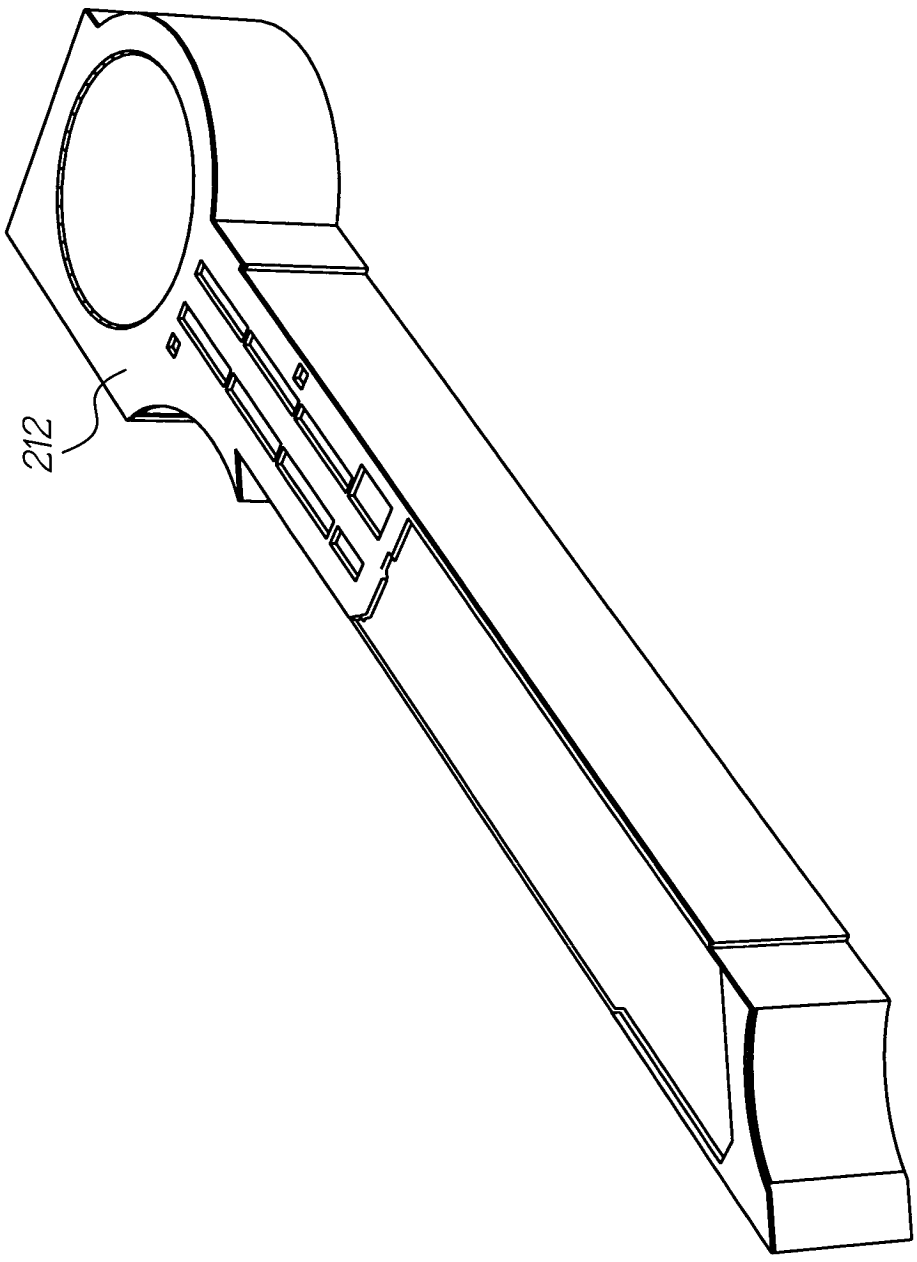
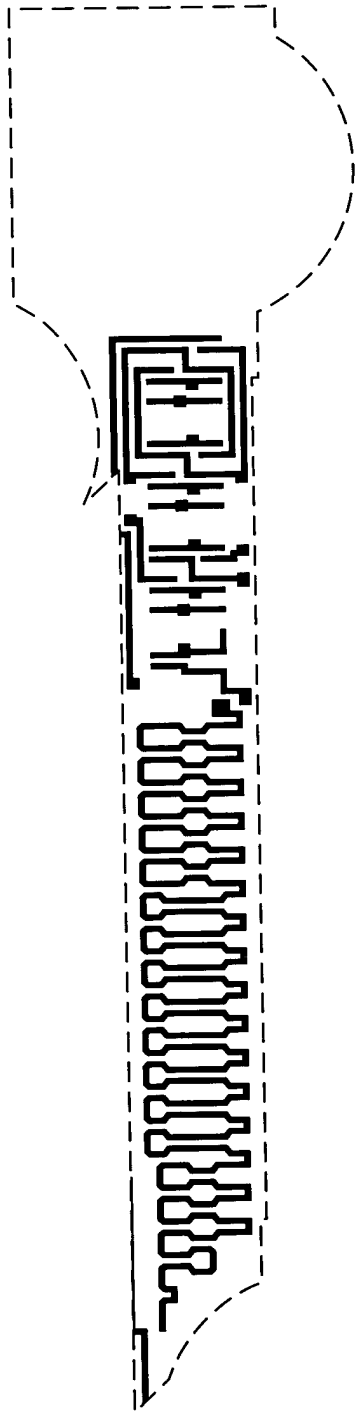
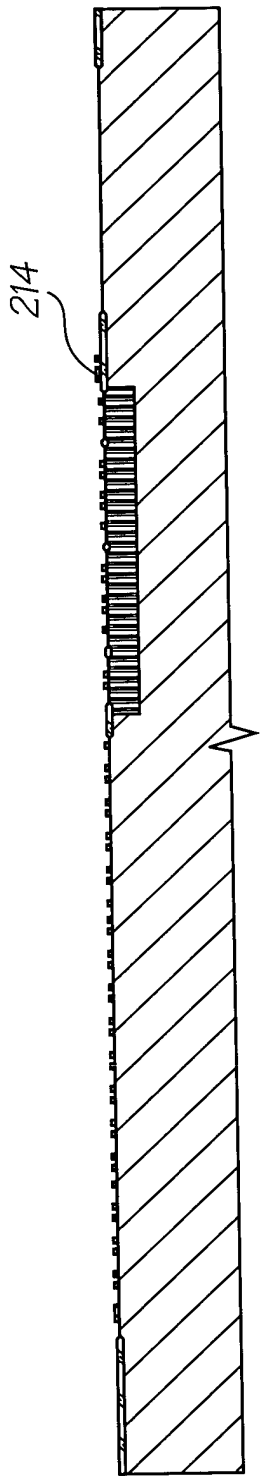


FIG. 24



Poly mask

FIG. 25



Deposit poly

FIG. 26

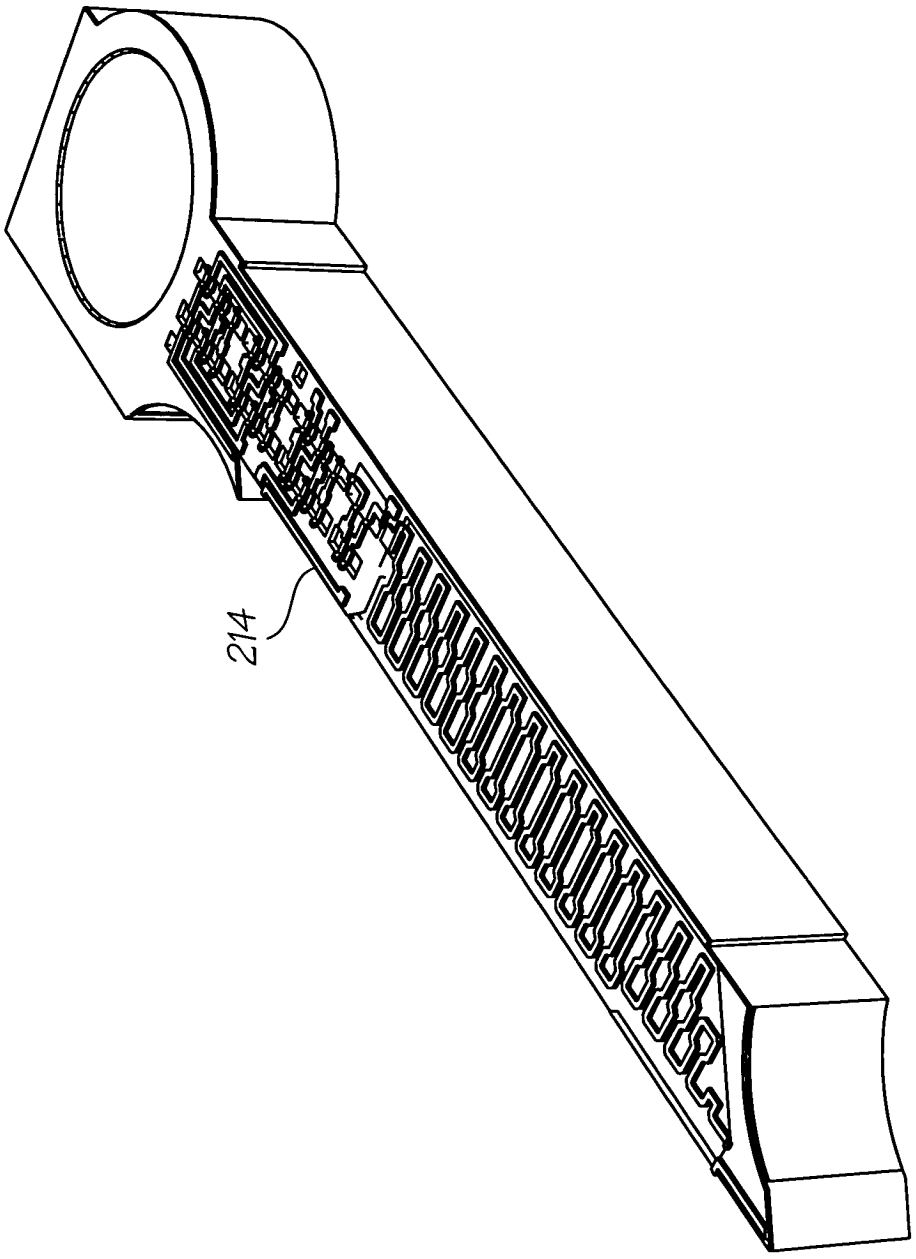


FIG. 27

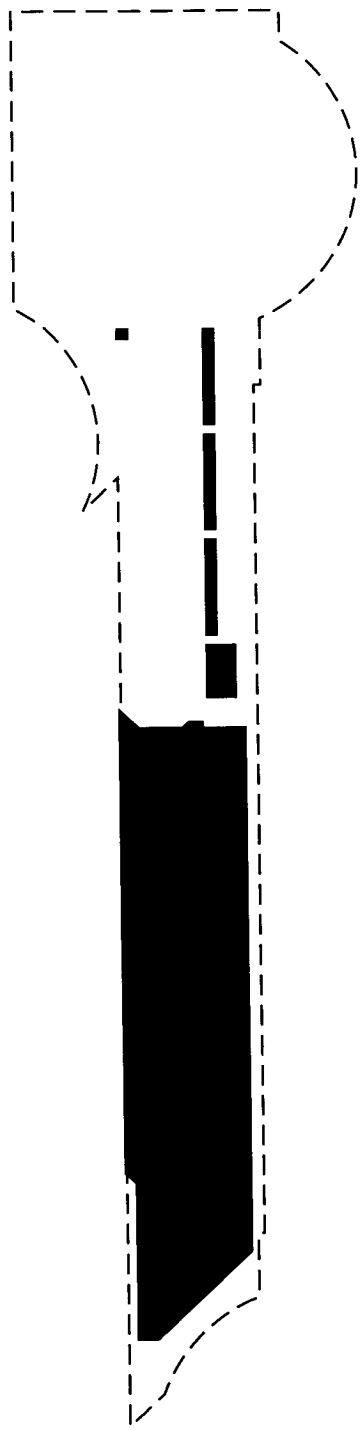


FIG. 28

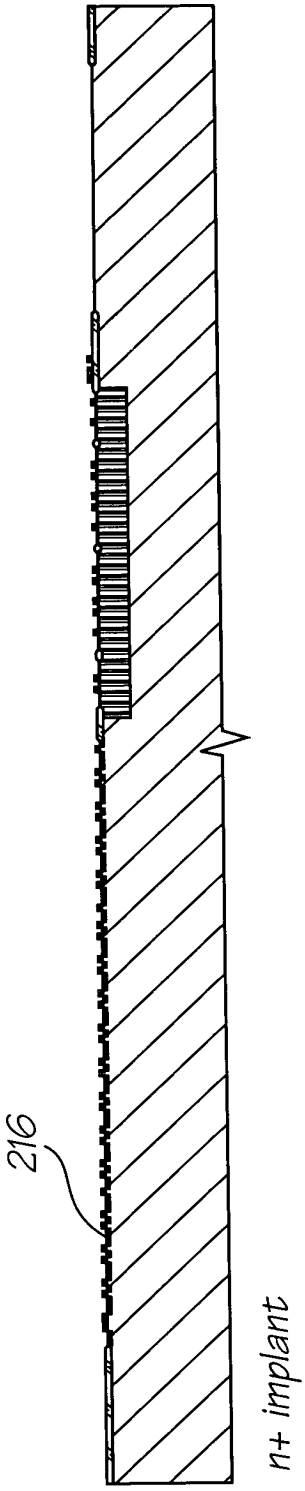


FIG. 29

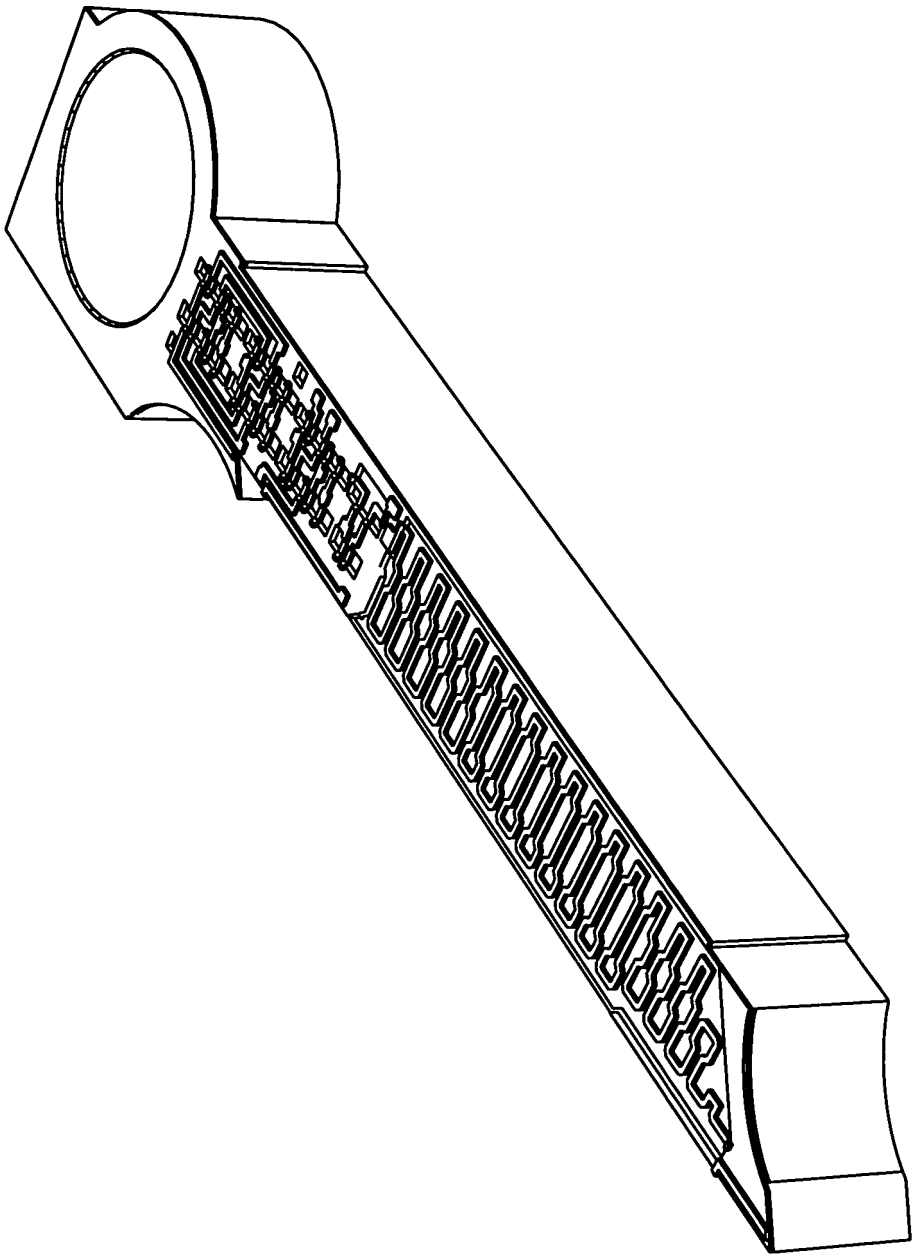


FIG. 30

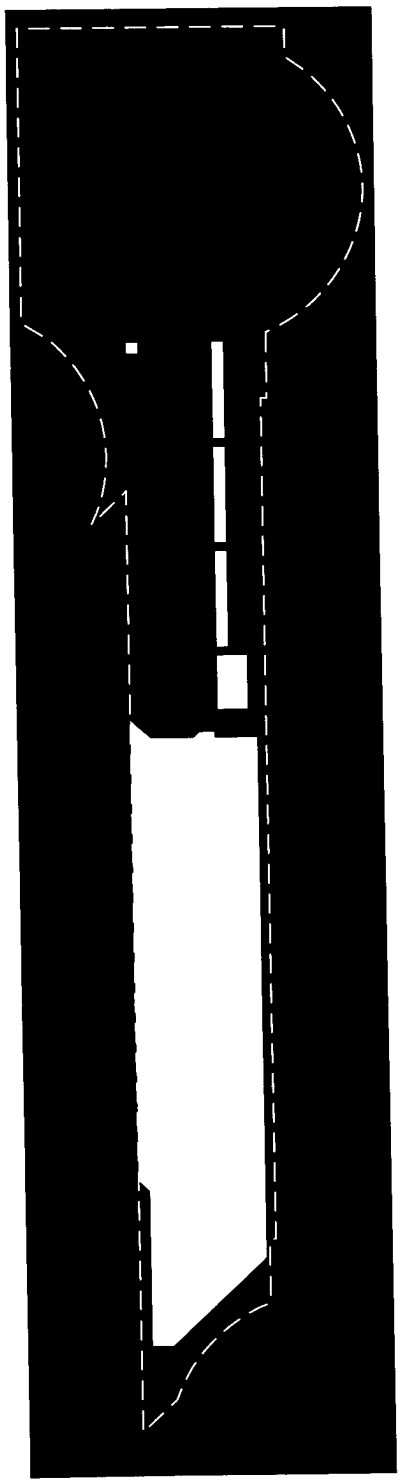


FIG. 31

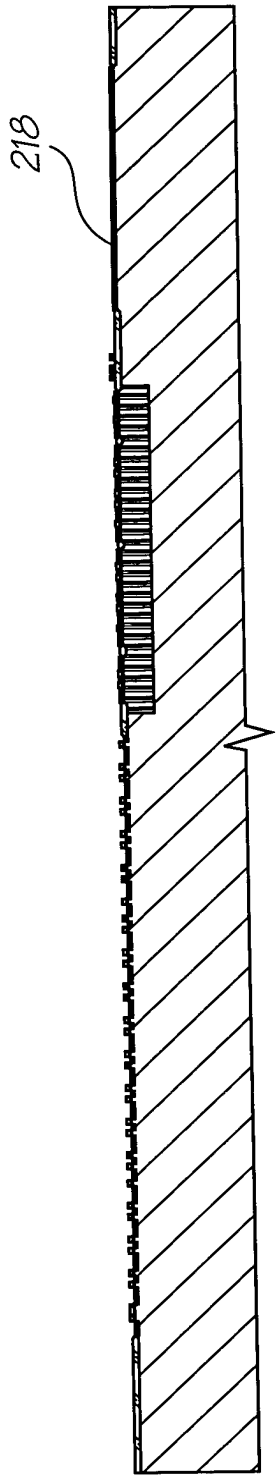


FIG. 32

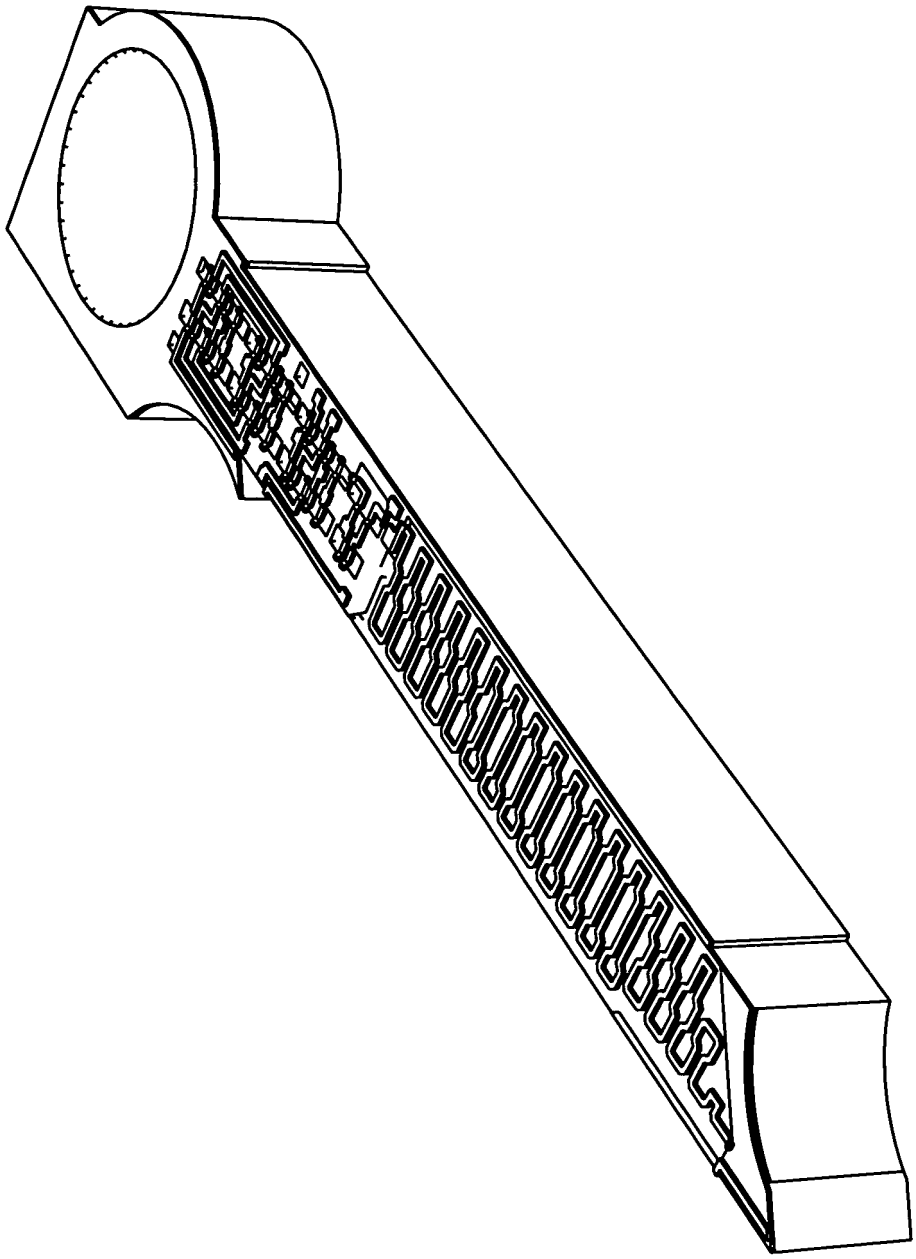
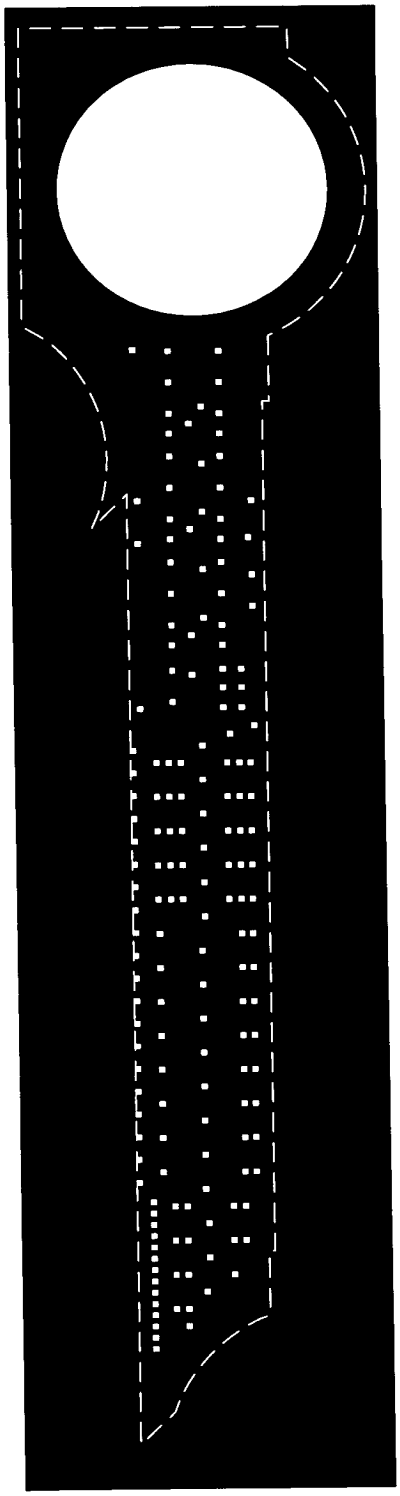
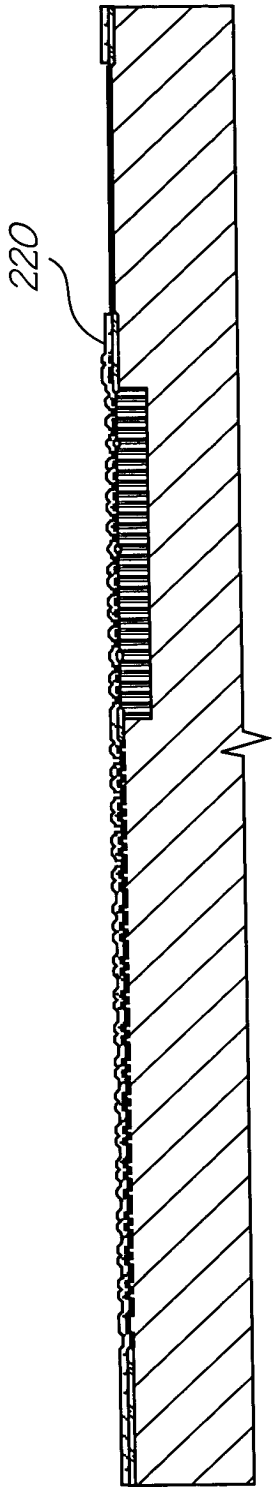


FIG. 33



Contacts mask

FIG. 34



Deposit ILD 1, etch contacts

FIG. 35

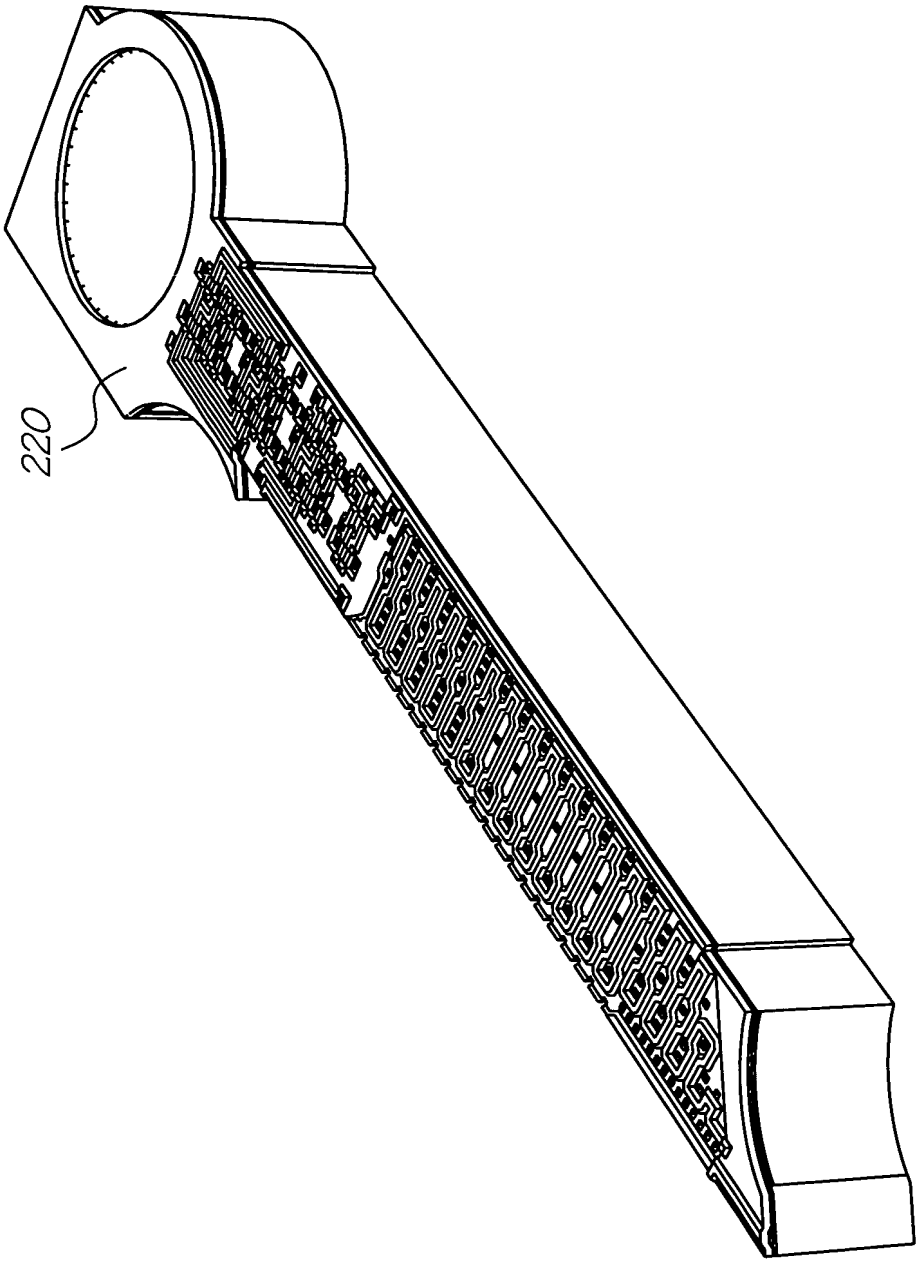
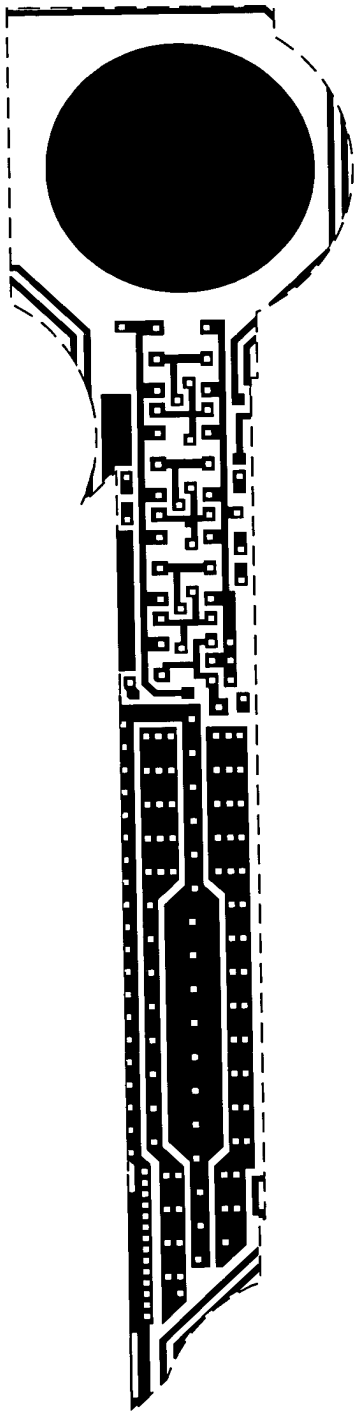
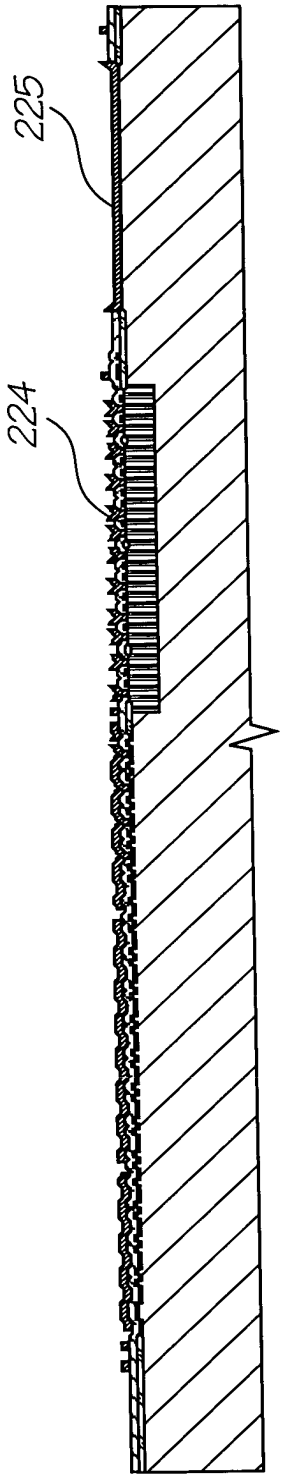


FIG. 36



Metal 1 mask

FIG. 37



Deposit Metal 1

FIG. 38

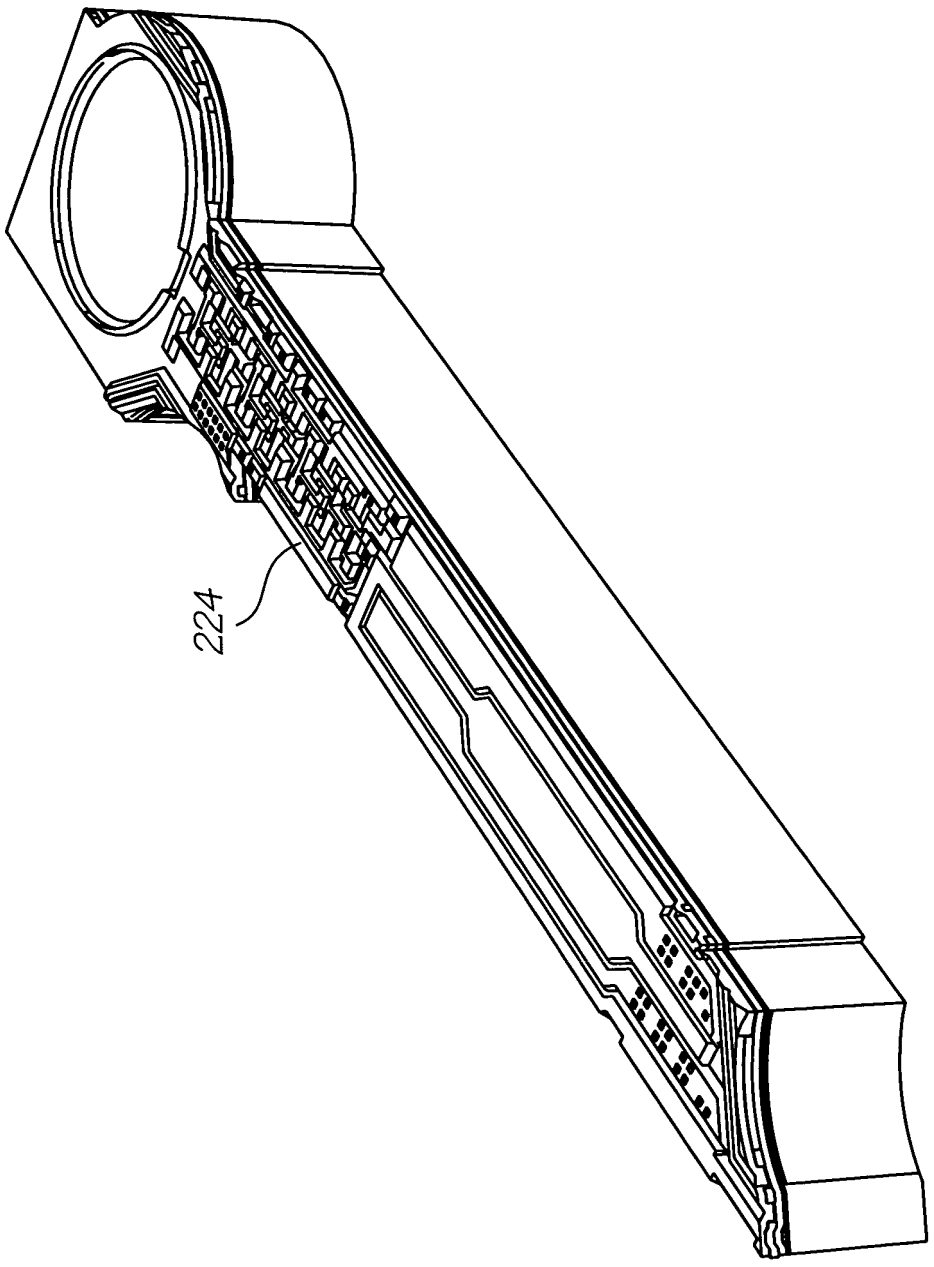


FIG. 39

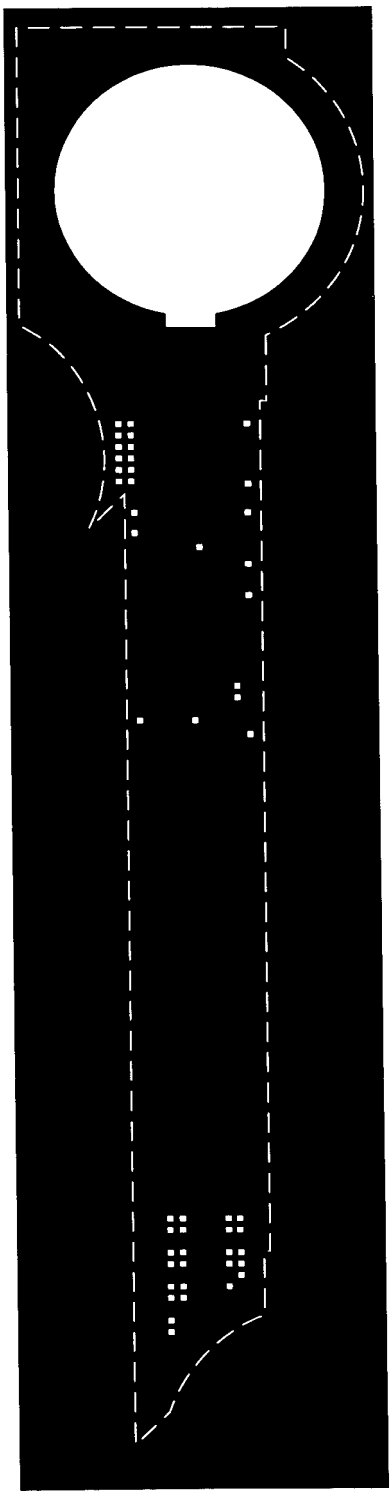


FIG. 40

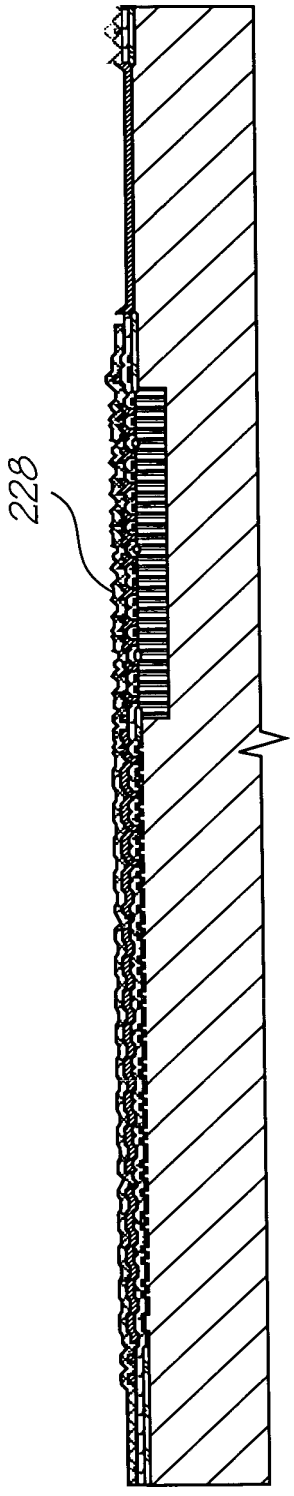


FIG. 41

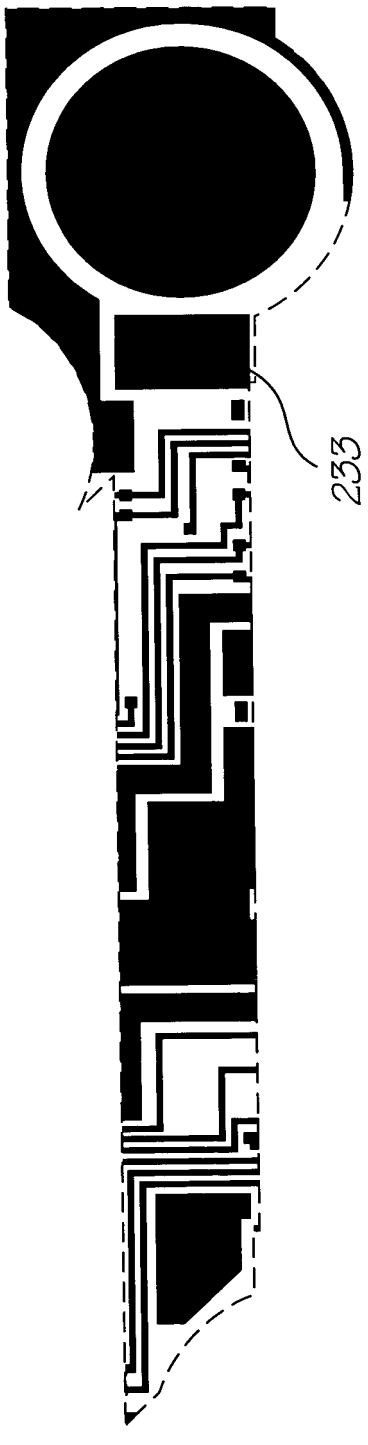


FIG. 42

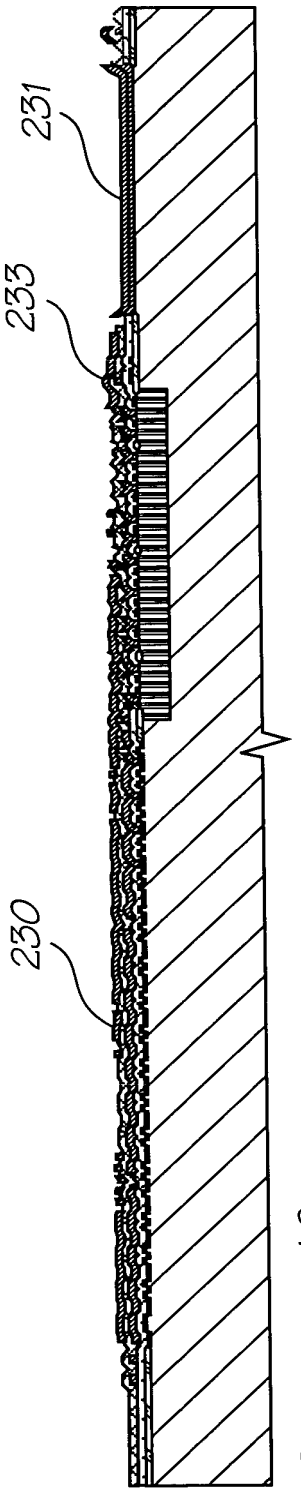


FIG. 43

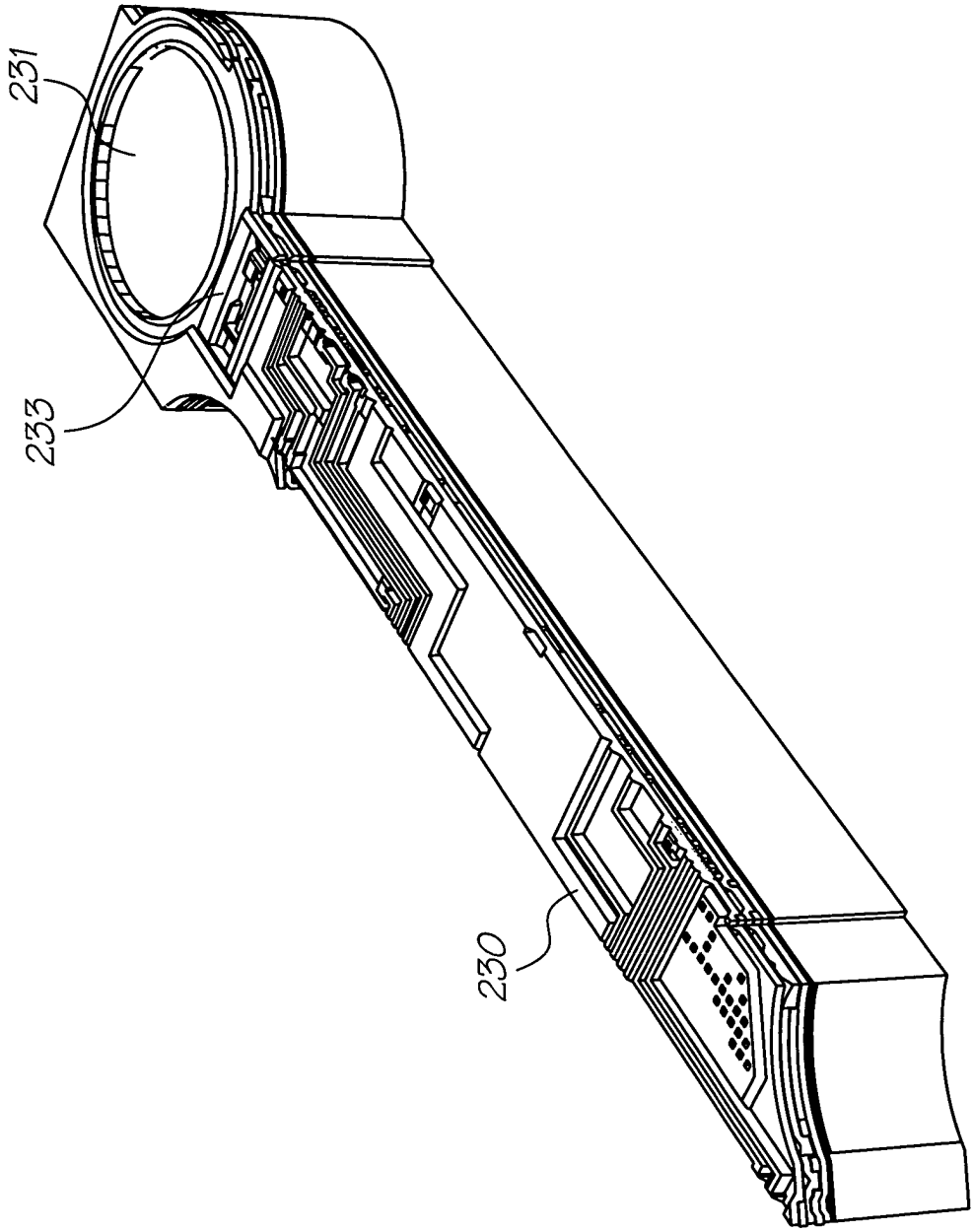


FIG. 44

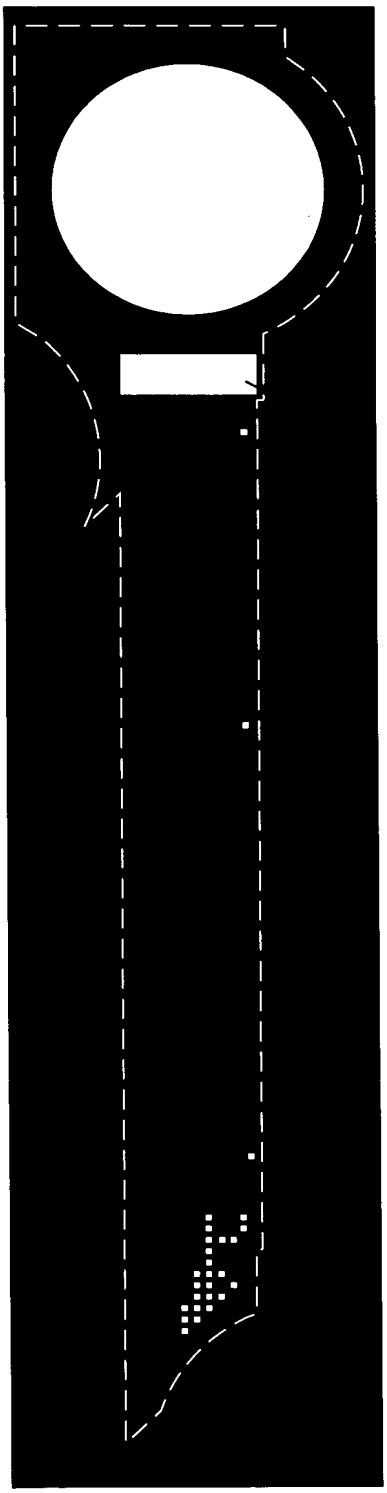


FIG. 45

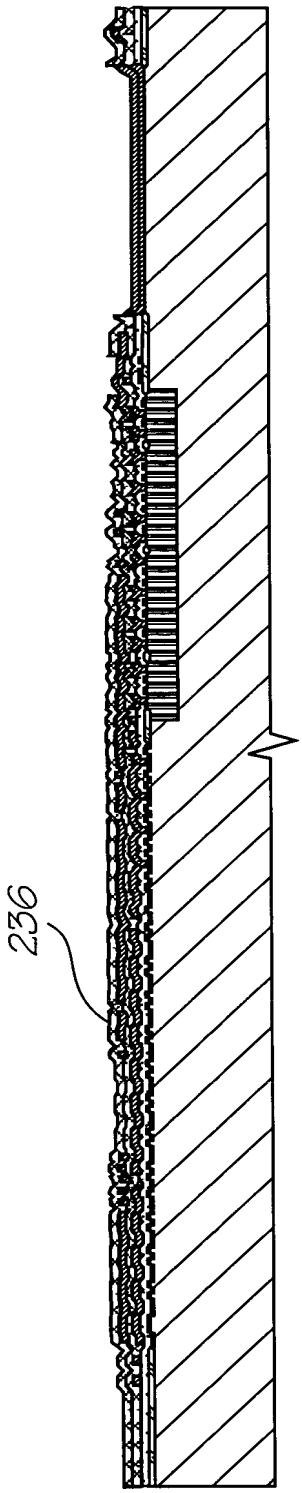
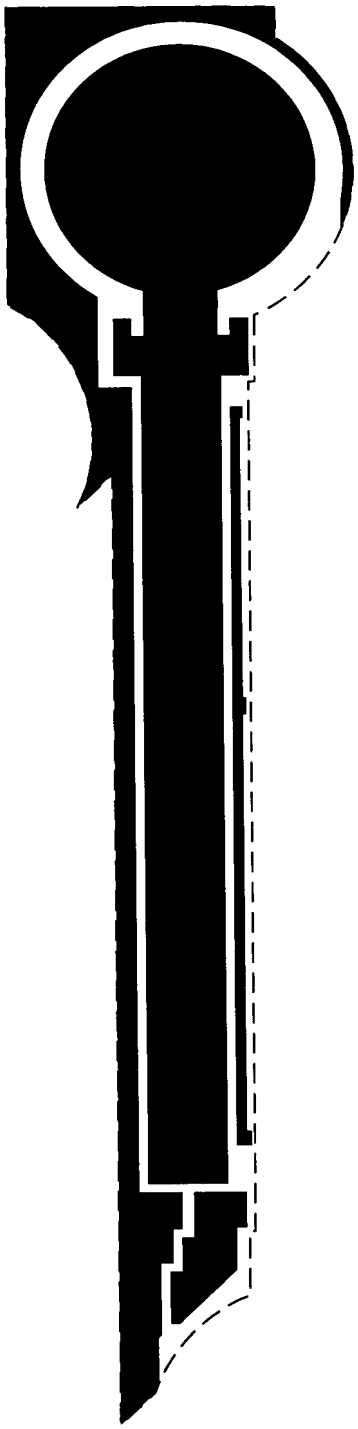
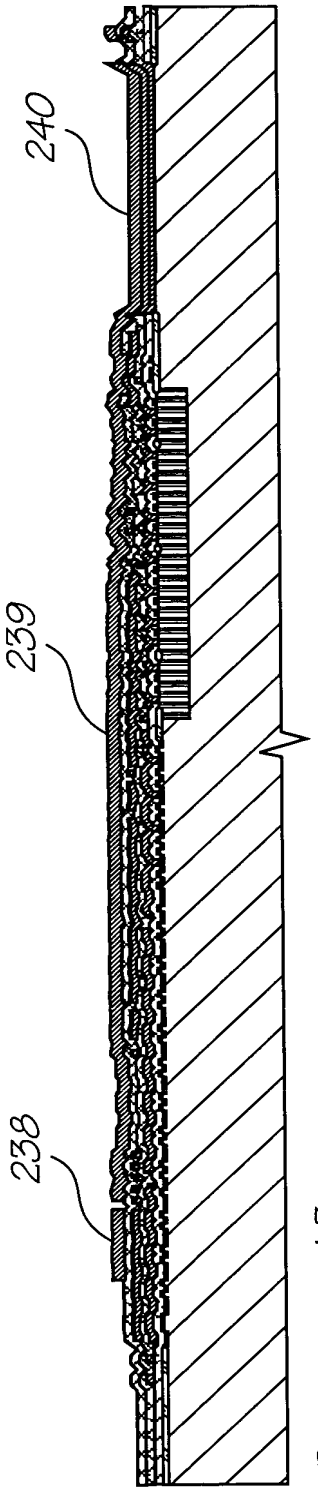


FIG. 46



Metal 3 mask

FIG. 47



Deposit metal 3

FIG. 48

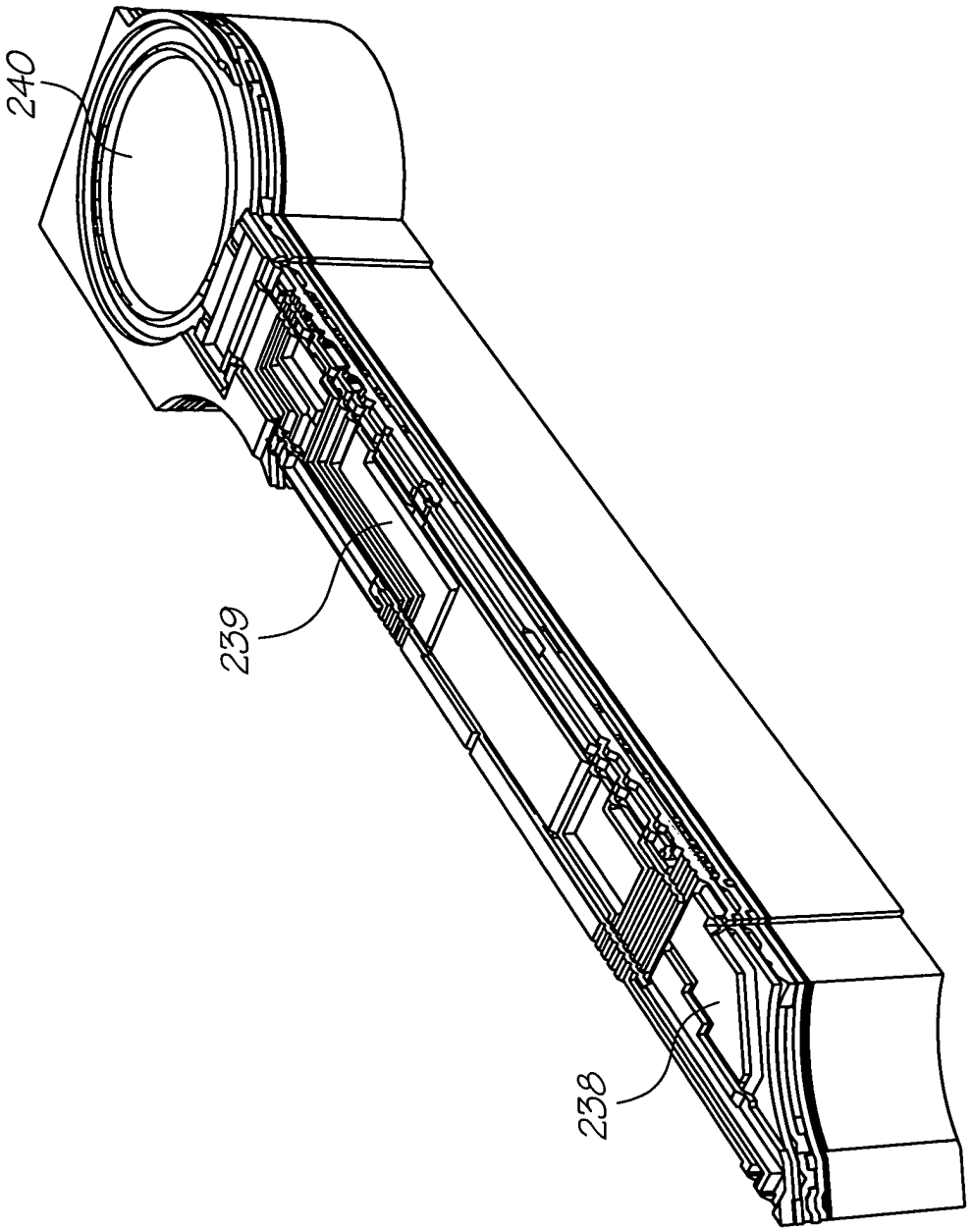


FIG. 49

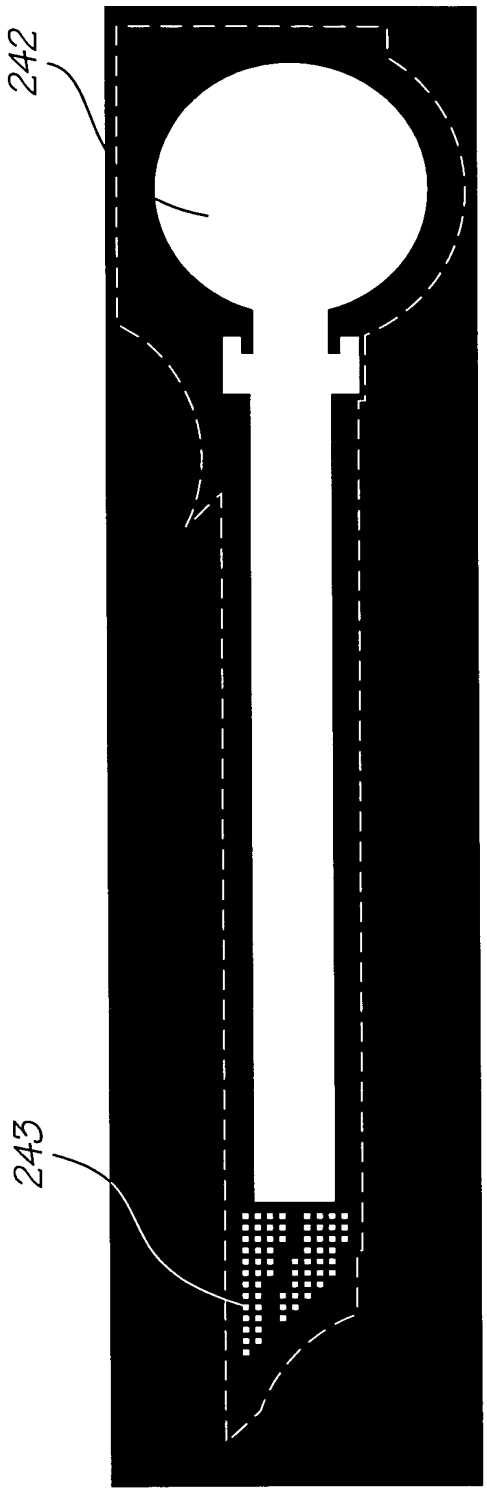

242
243
Via 3 / Passivation mask

FIG. 50

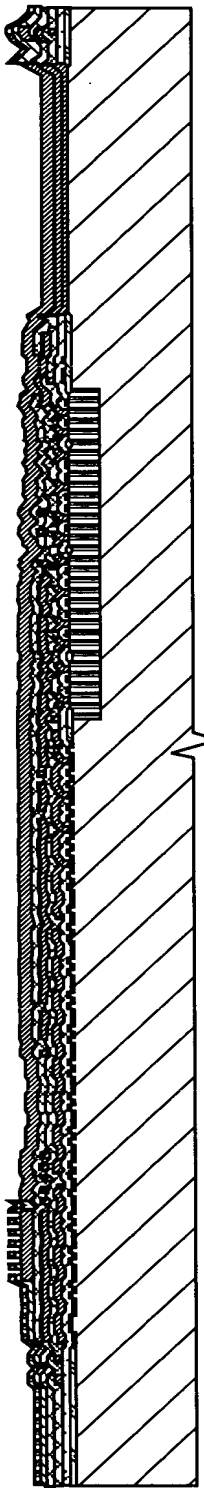

Deposit passivation oxide & nitride, etch vias

FIG. 51

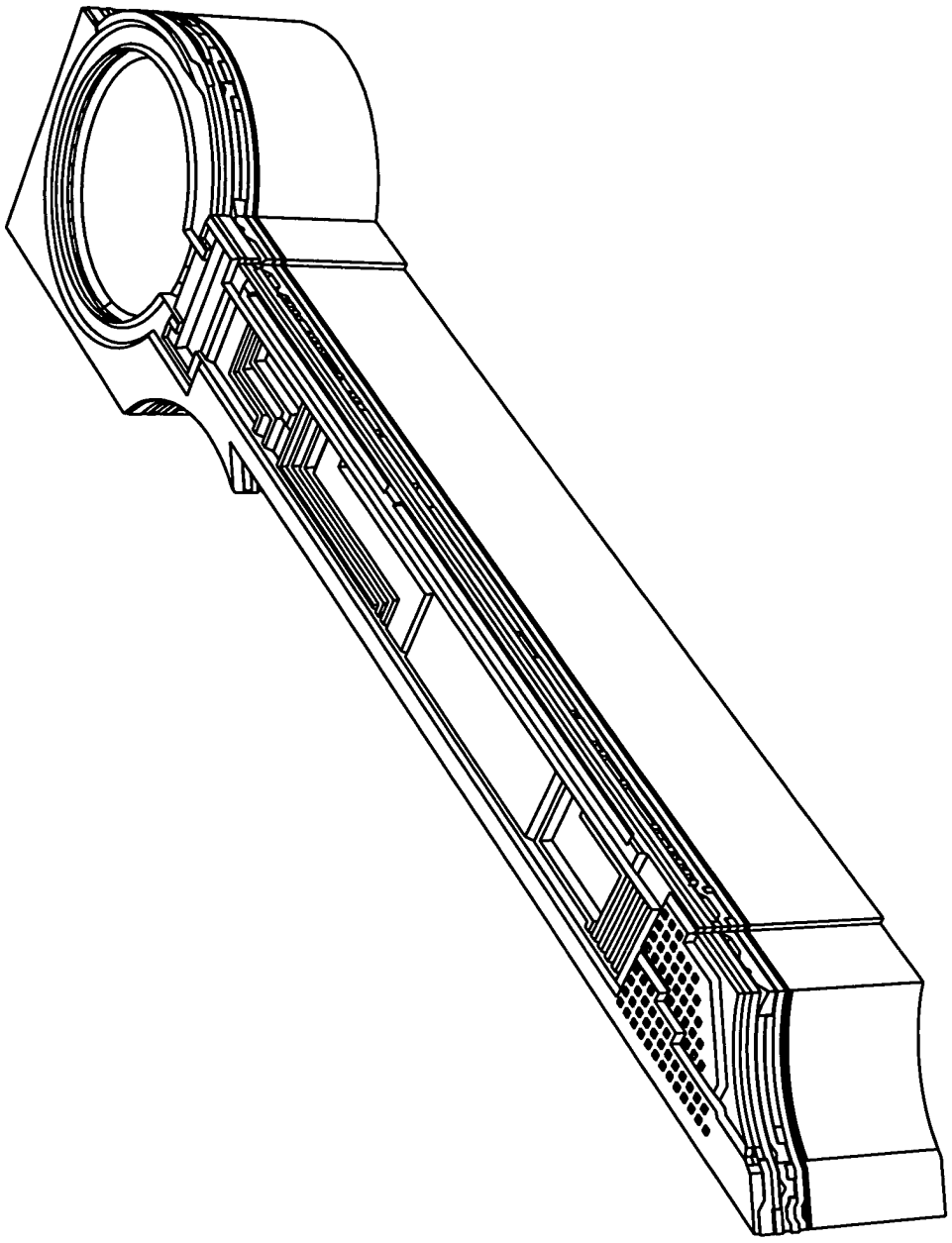
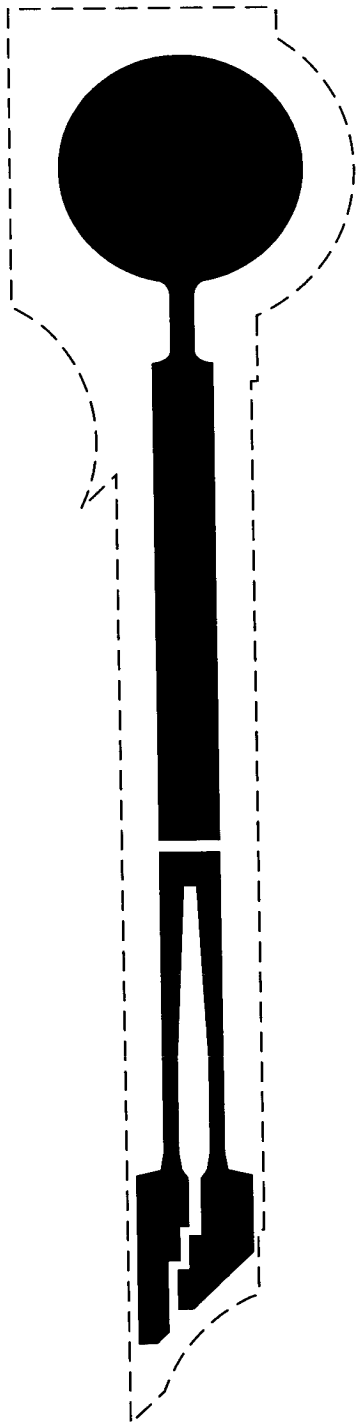
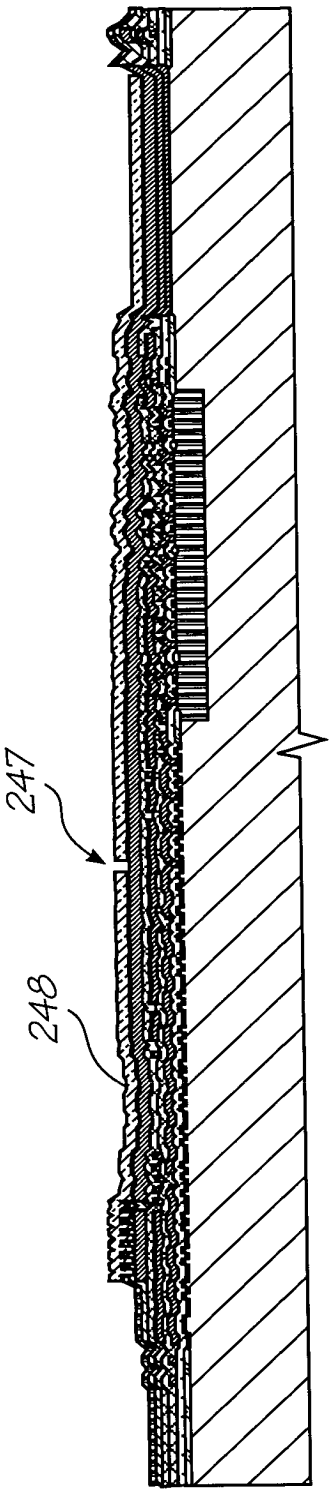


FIG. 52



Heater mask

FIG. 53



Deposit heater TiN

FIG. 54

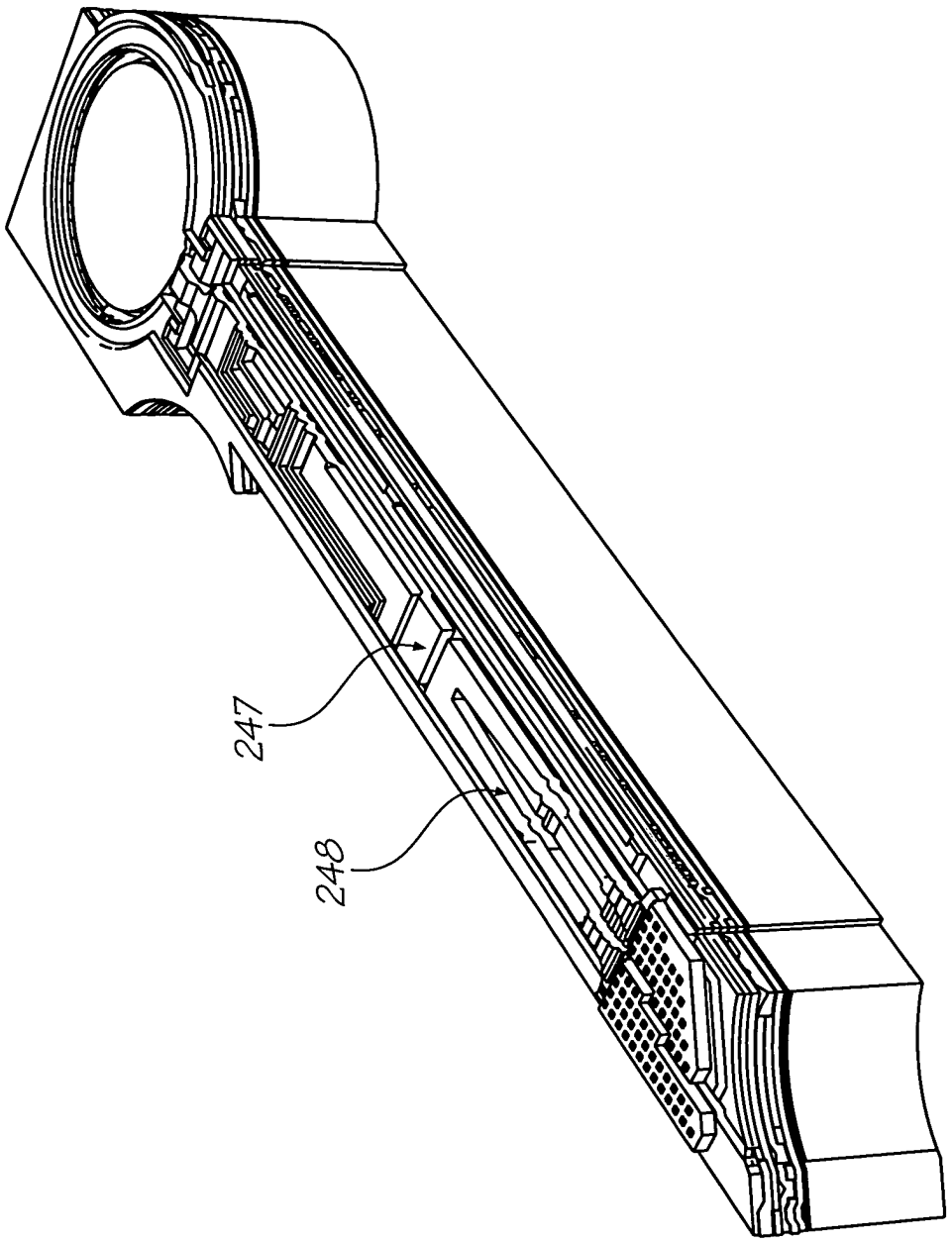
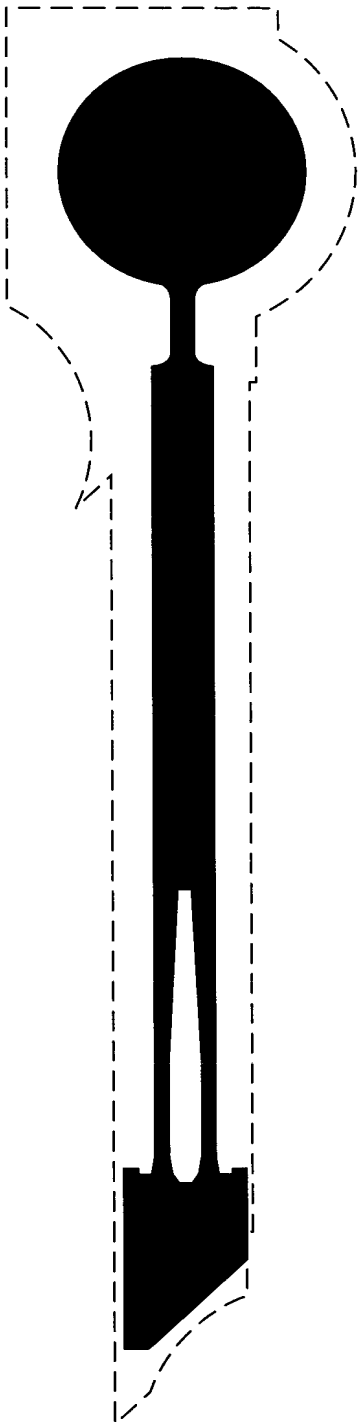
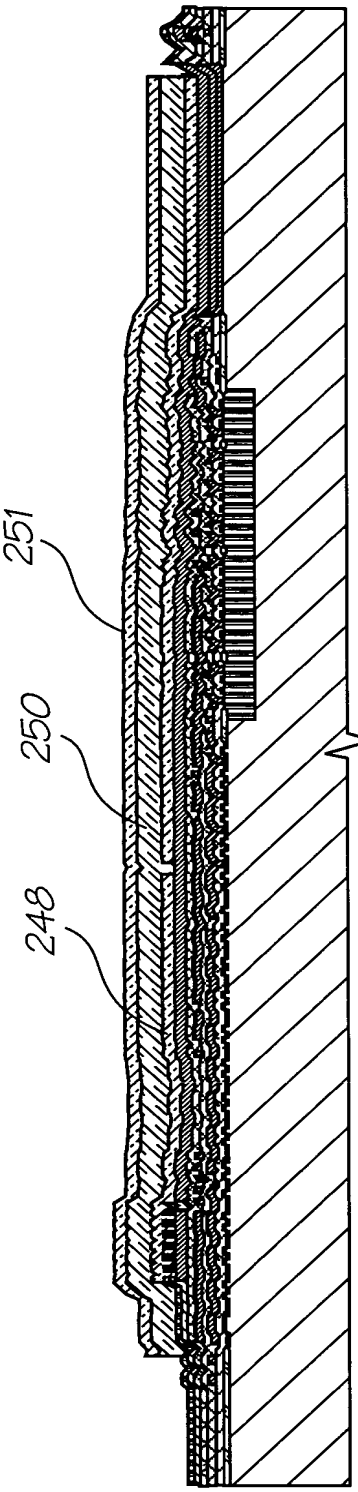


FIG. 55



Actuator / bend compensator mask

FIG. 56



Deposit actuator glass and bend compensator TiN, etch together

FIG. 57

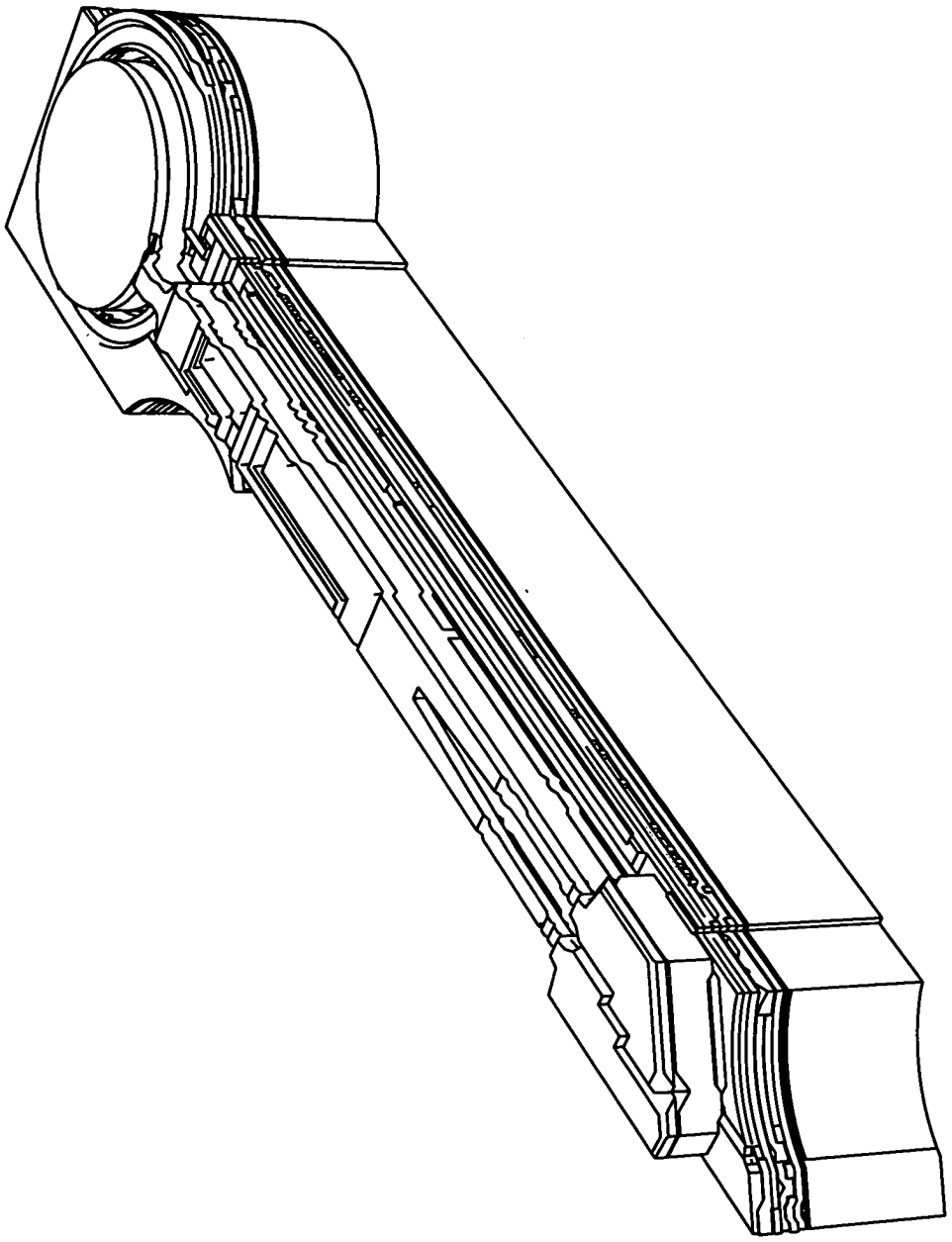
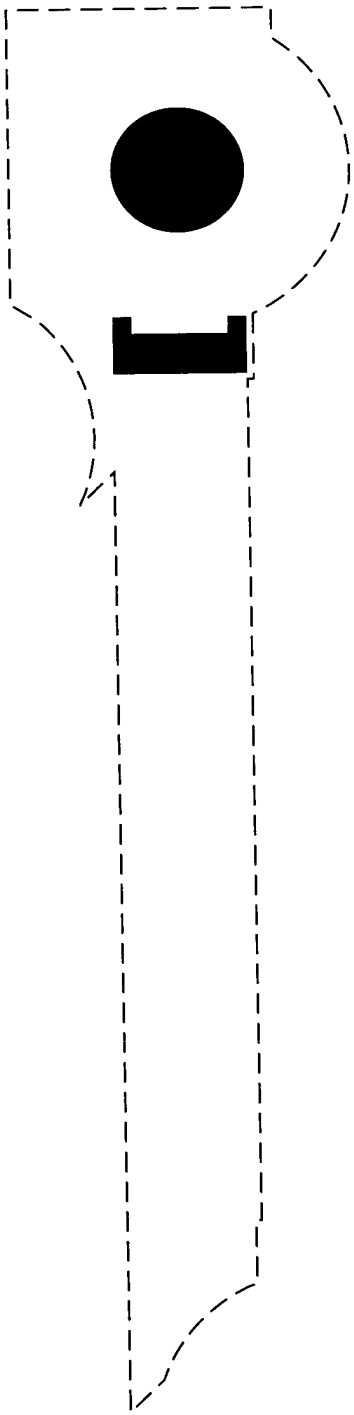
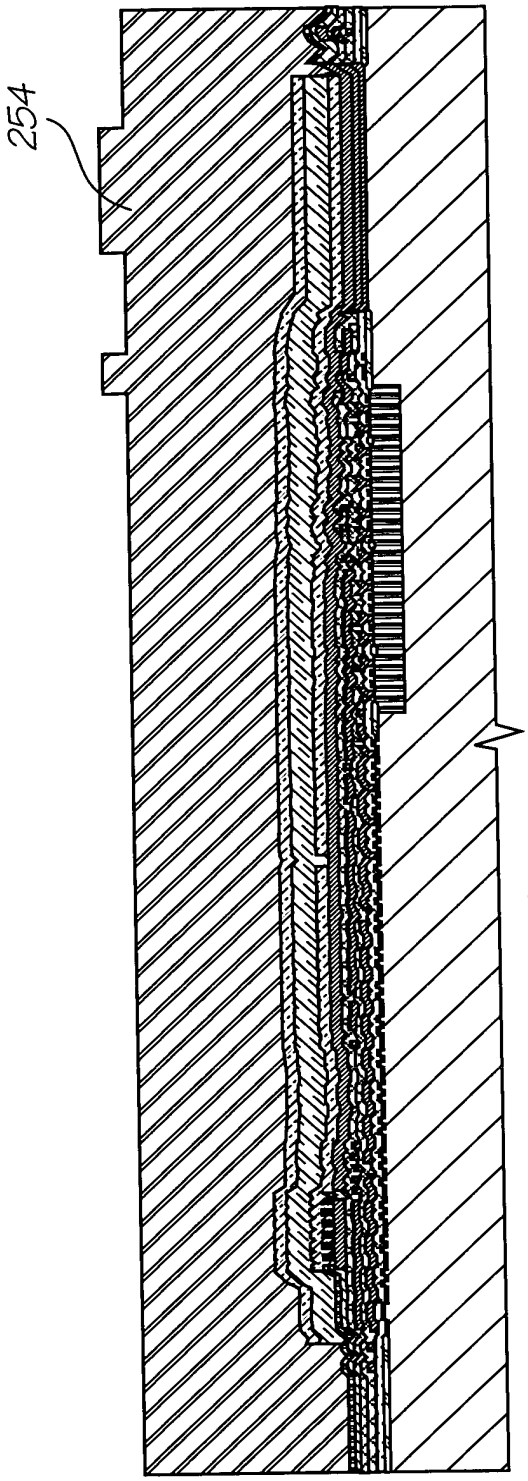


FIG. 58



Nozzle mask

FIG. 59



Deposit sacrificial layer, etch nozzles

FIG. 60

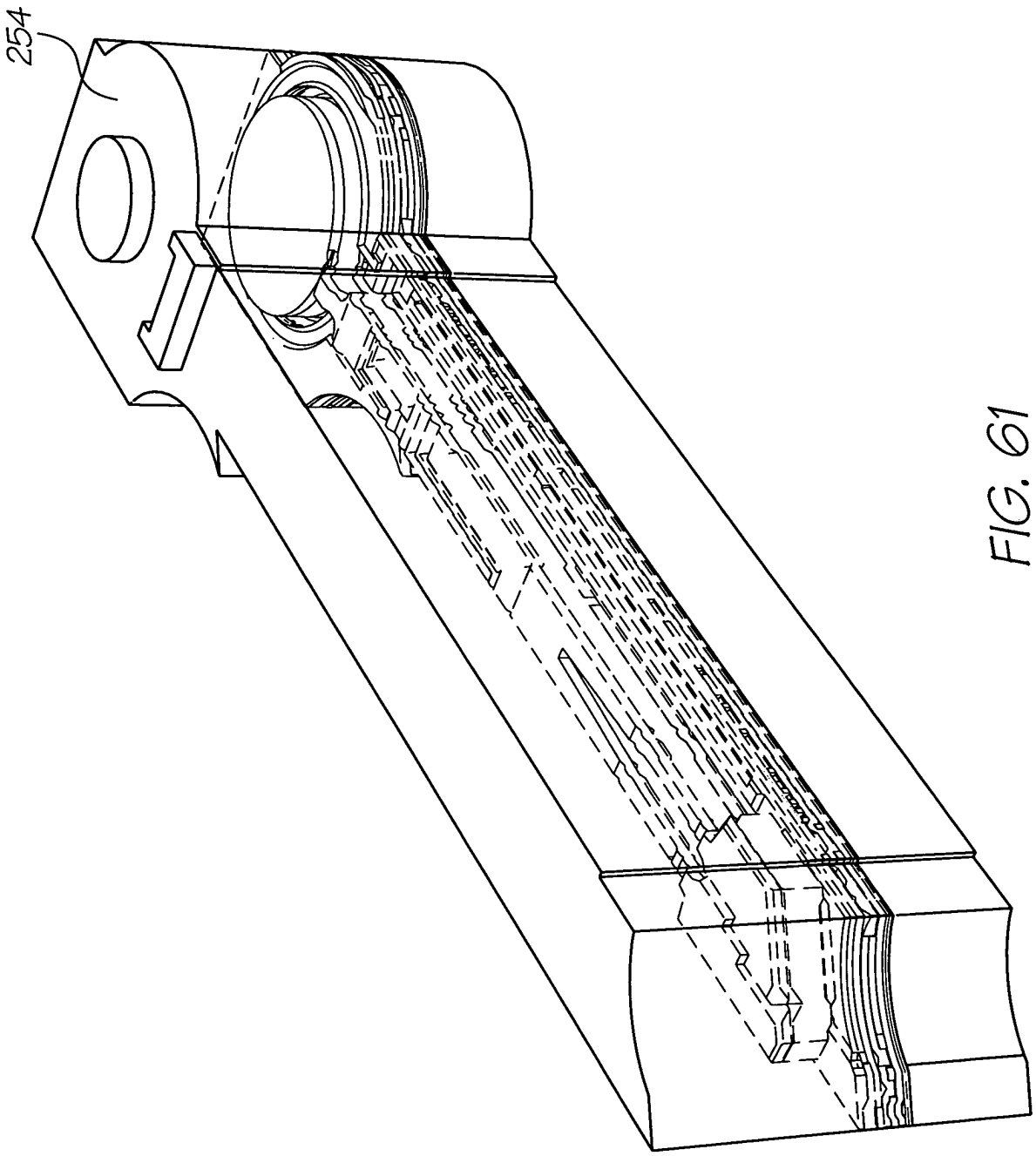
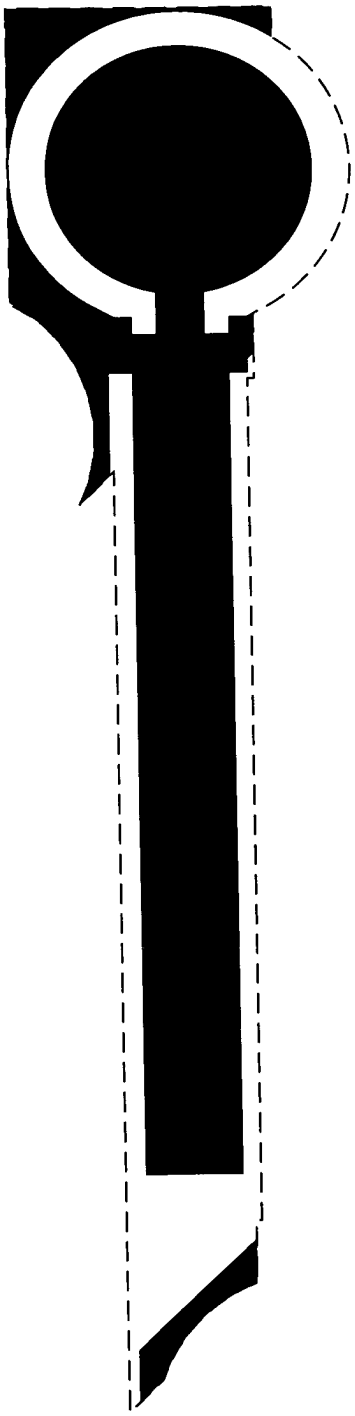
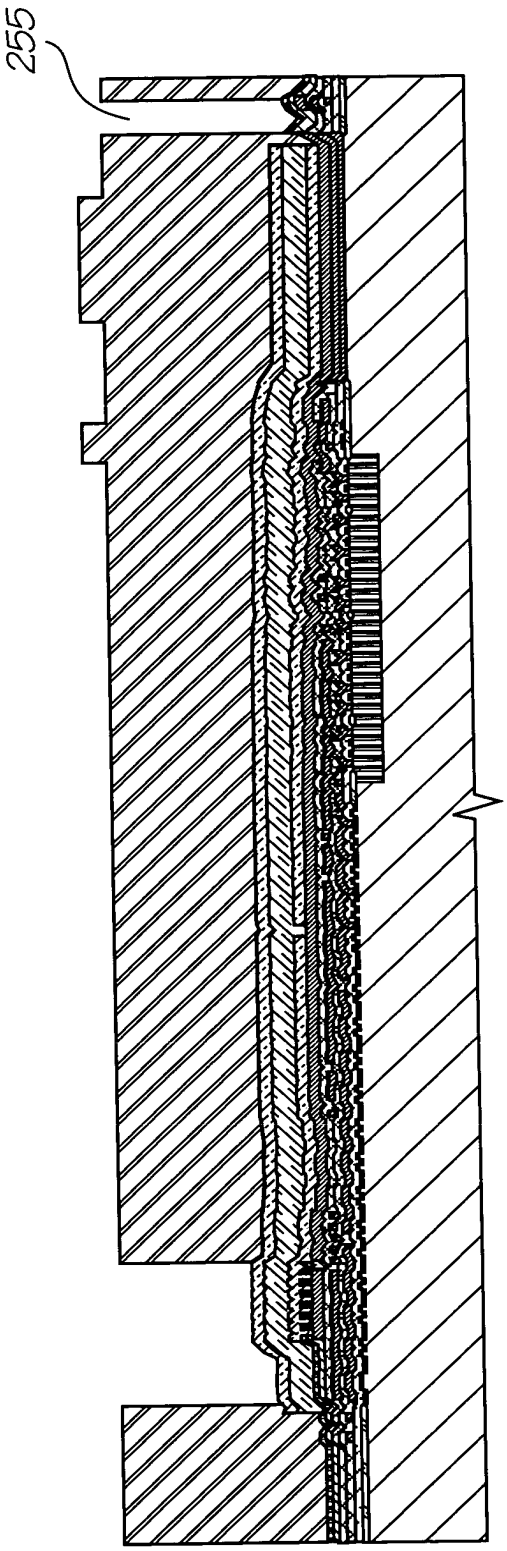


FIG. 61



Chamber mask

FIG. 62



Etch chambers in sacrificial layer

FIG. 63

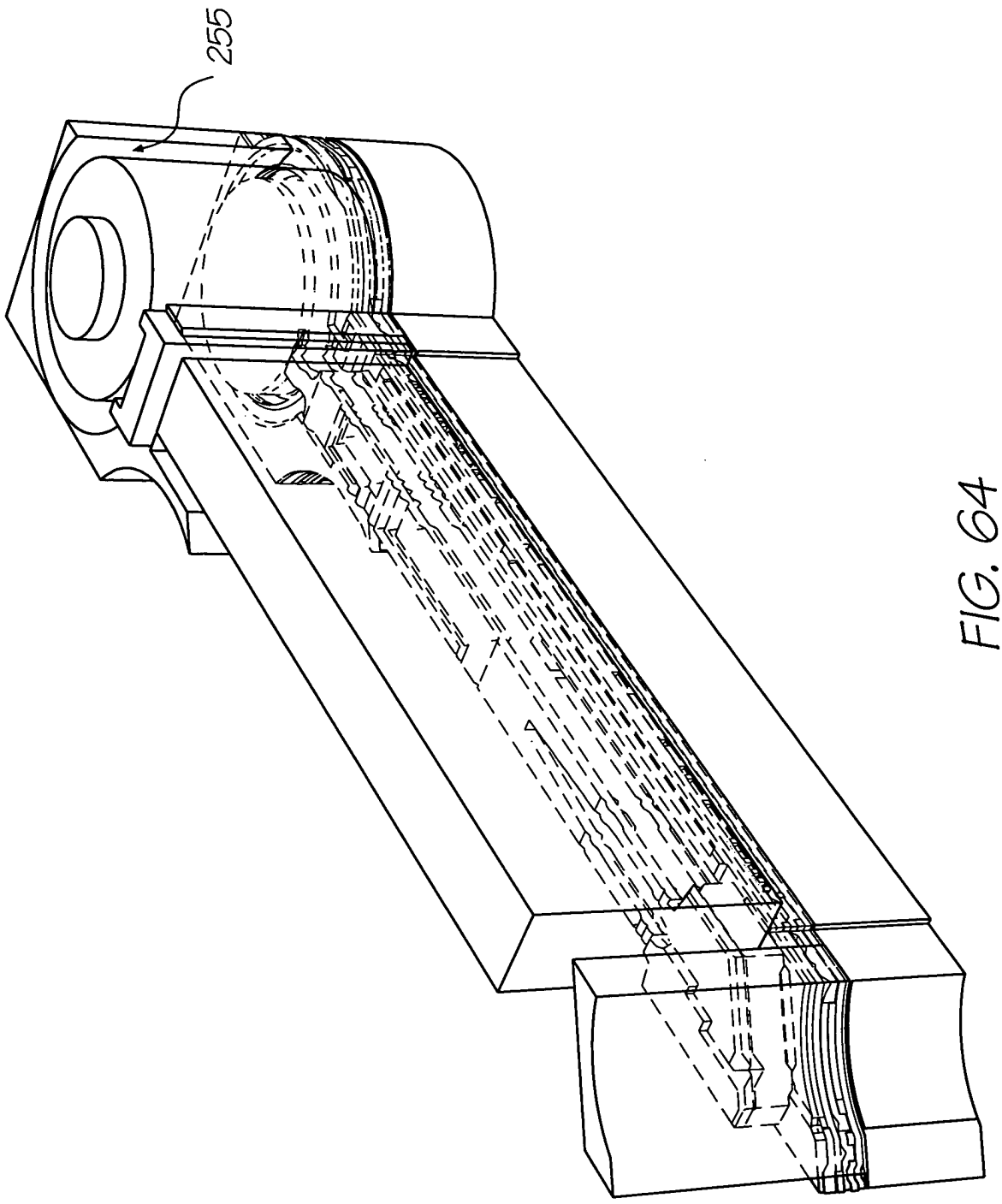


FIG. 64

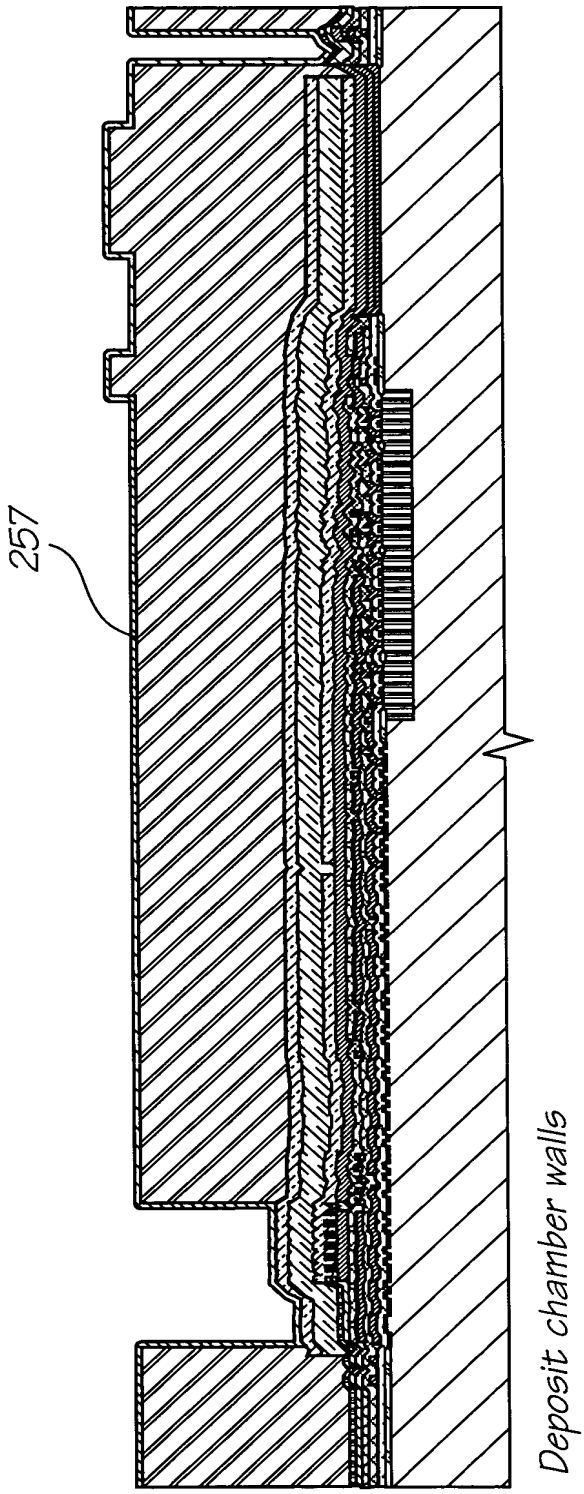


FIG. 65

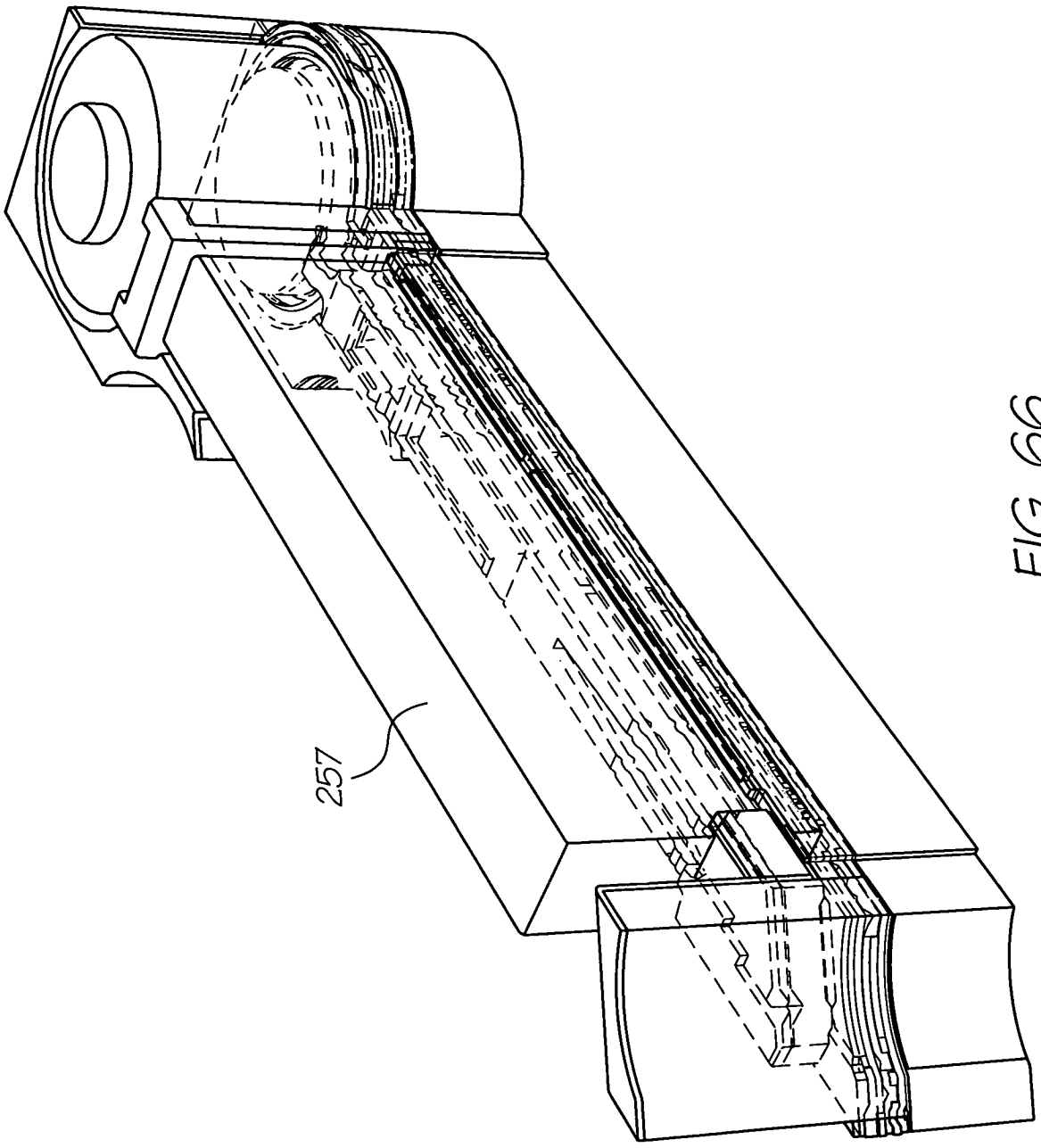


FIG. 66

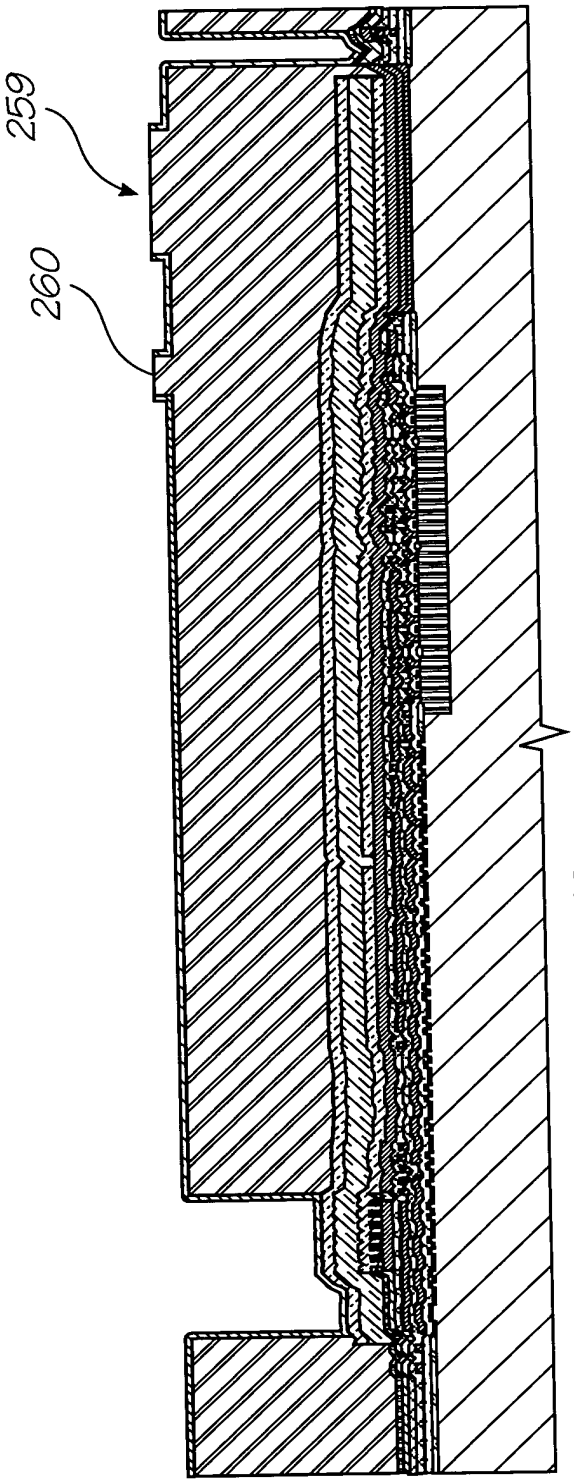


FIG. 67

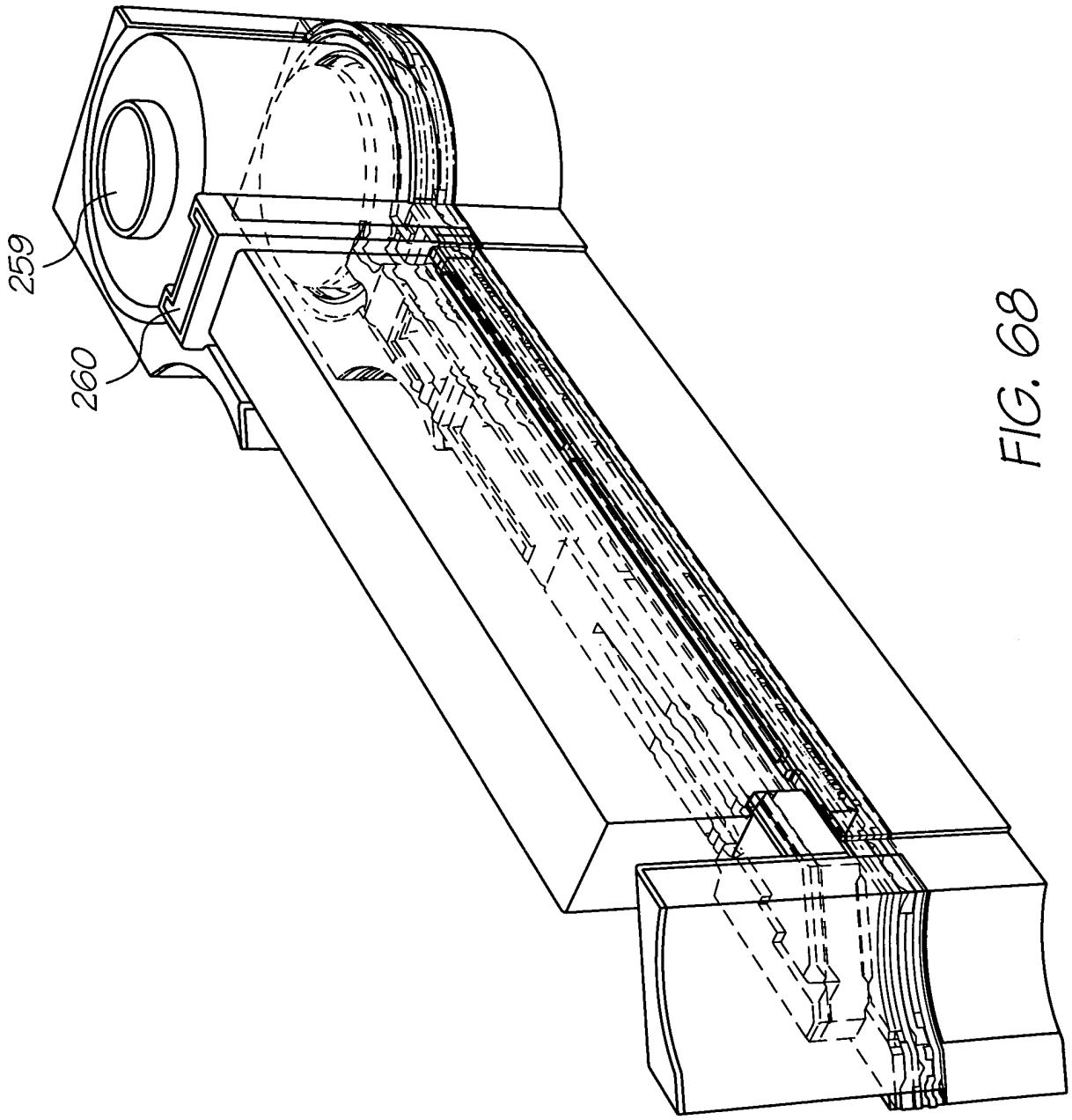
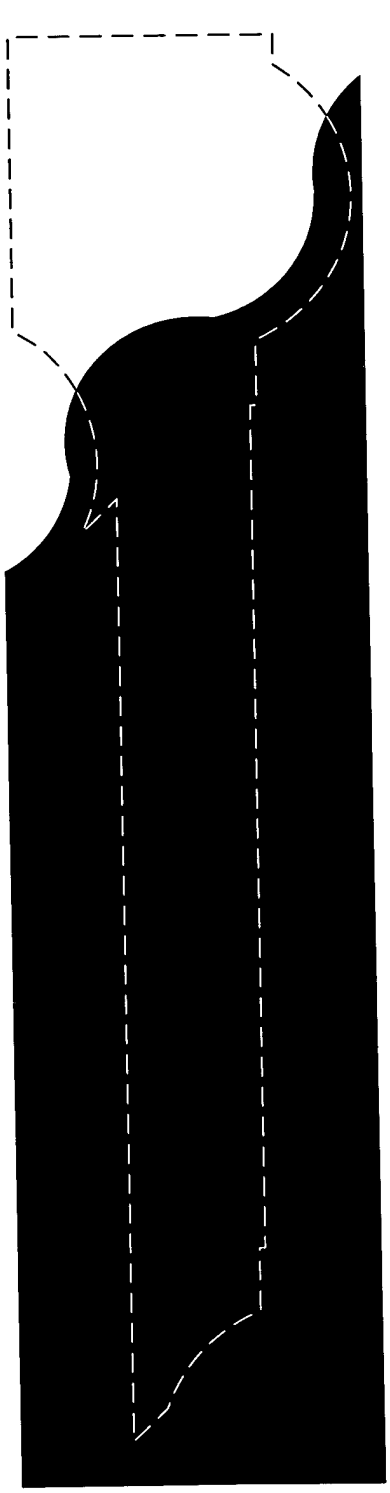
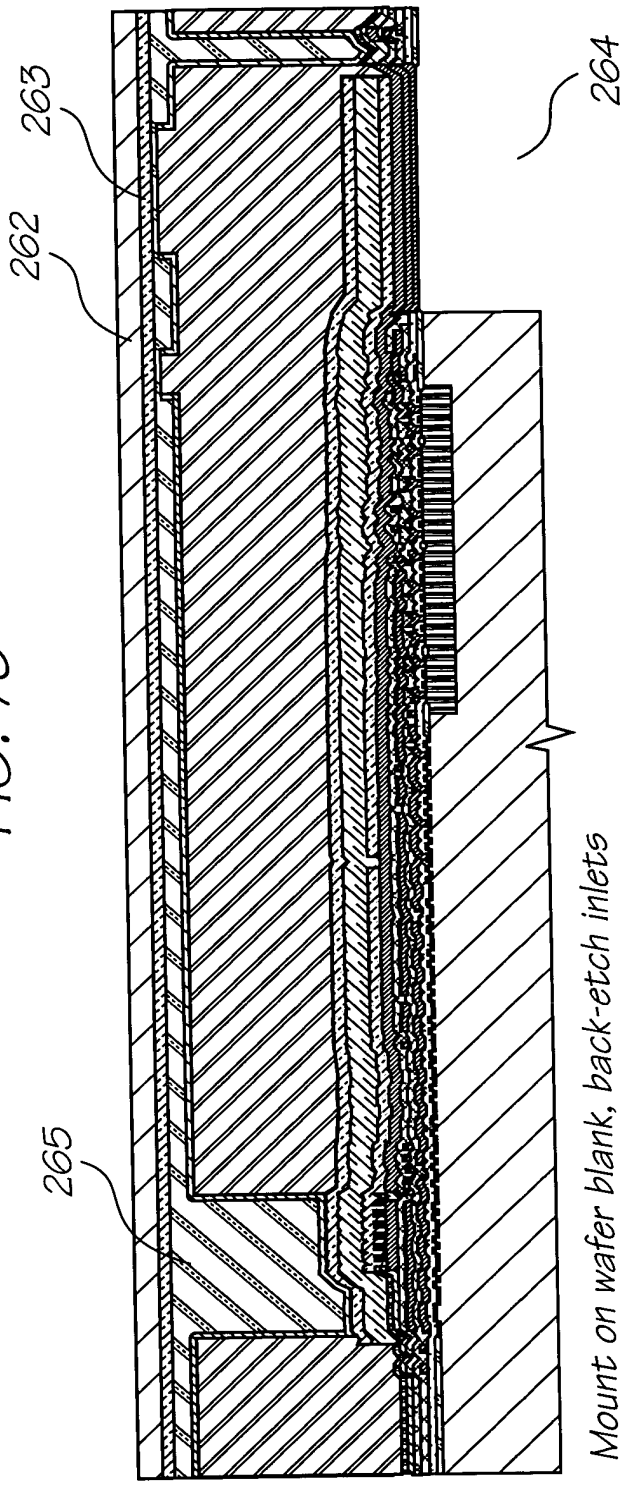


FIG. 68



Back-etch inlet mask

FIG. 70



Mount on wafer blank, back-etch inlets

FIG. 69

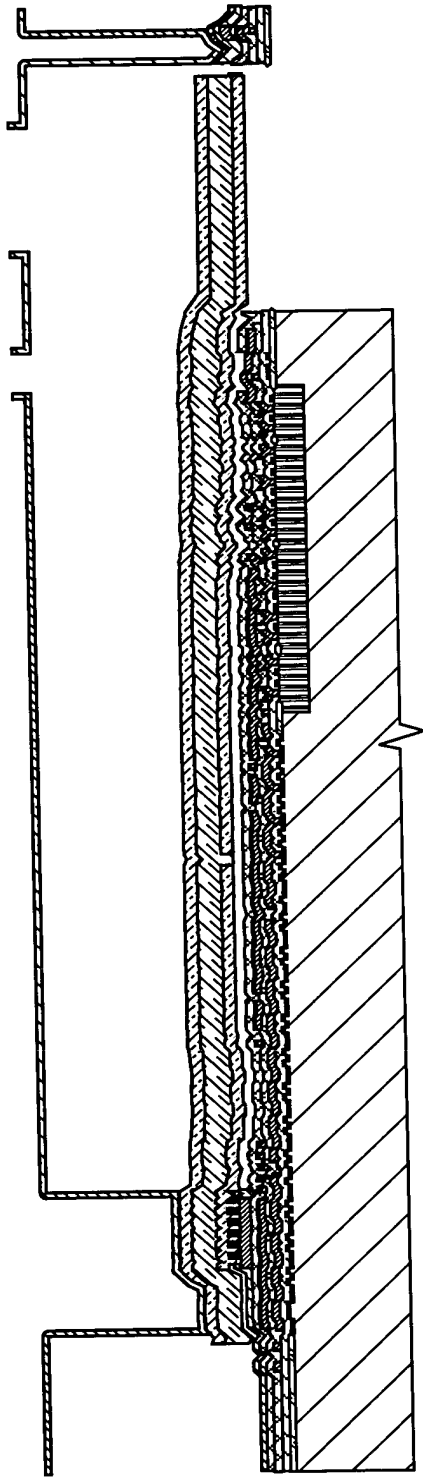


FIG. 71

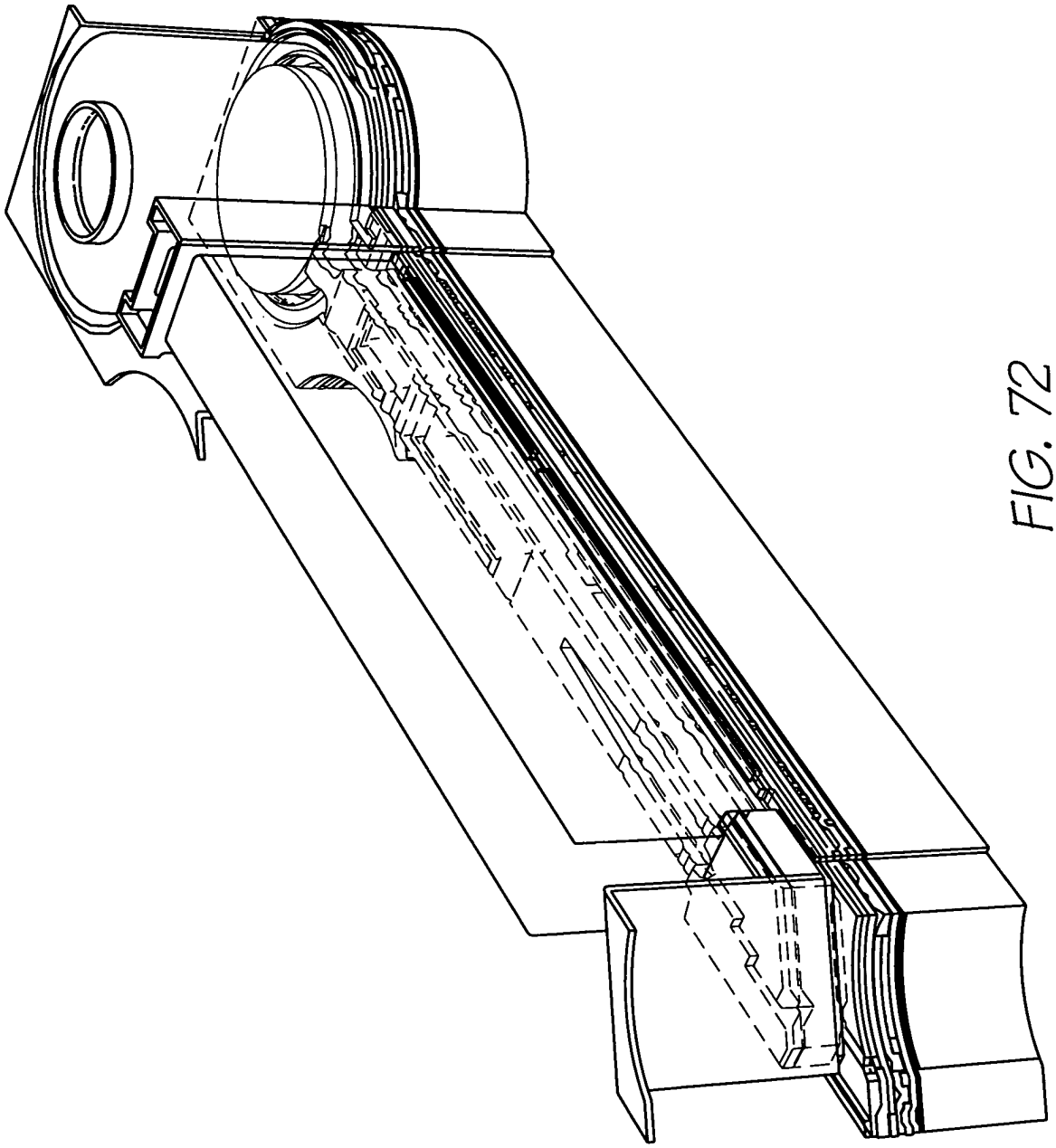


FIG. 72

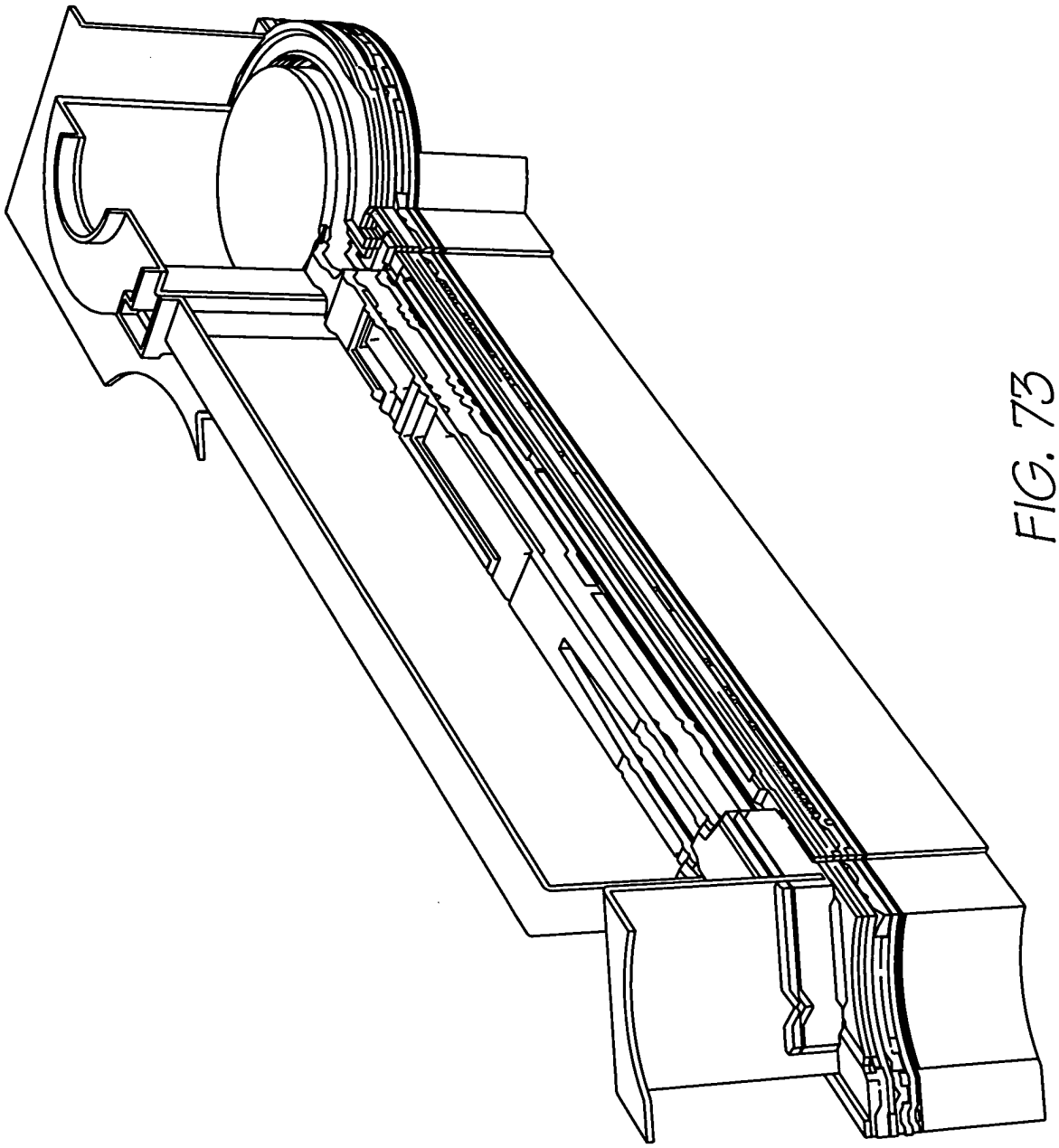


FIG. 73

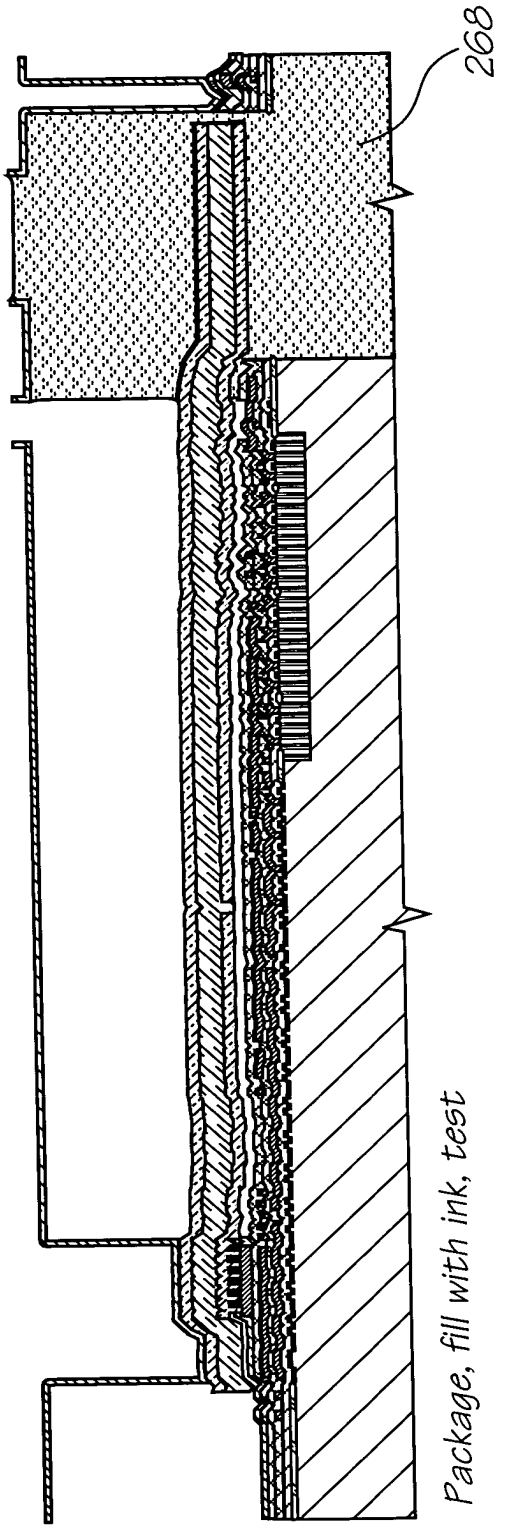


FIG. 74

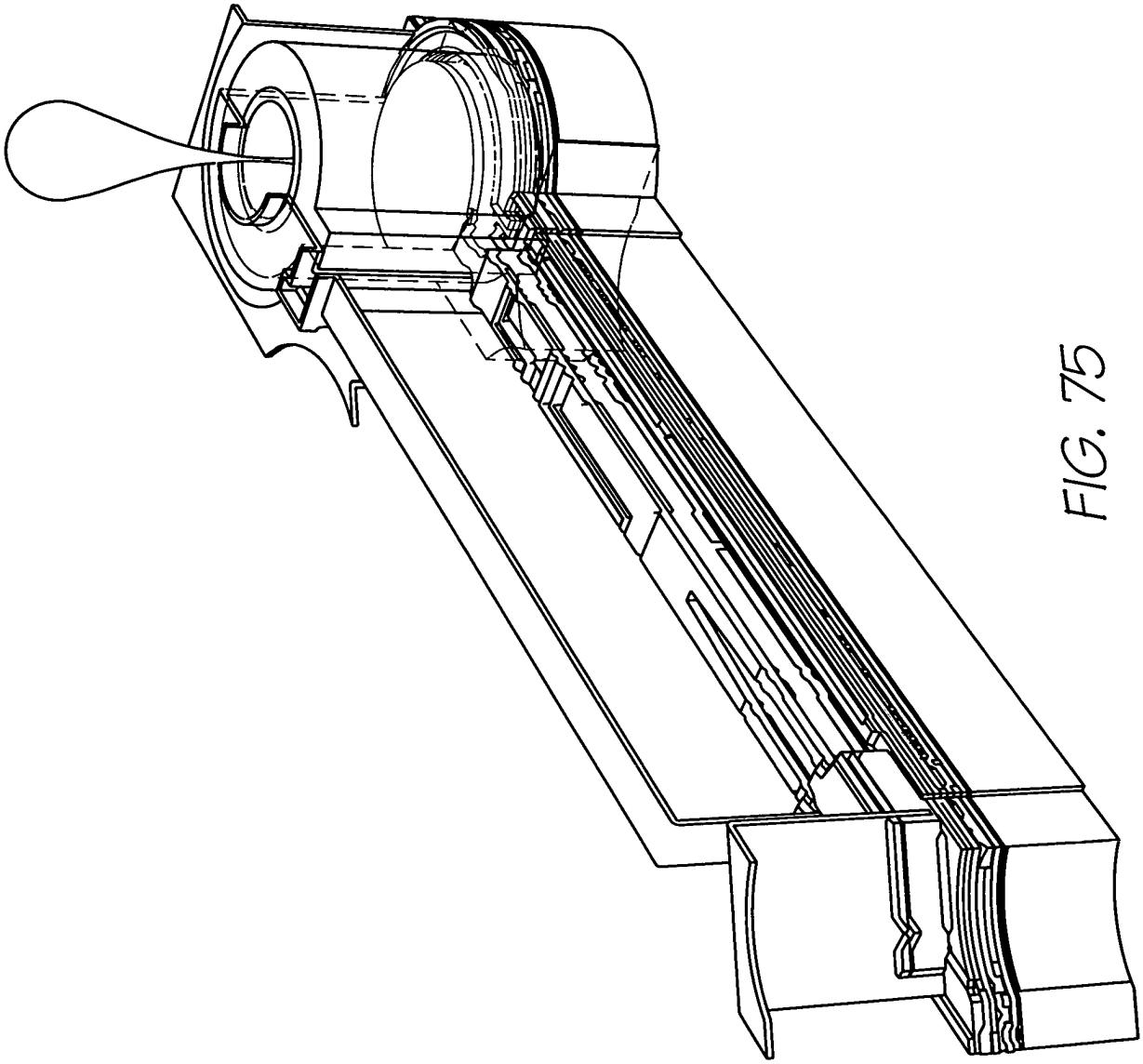


FIG. 75

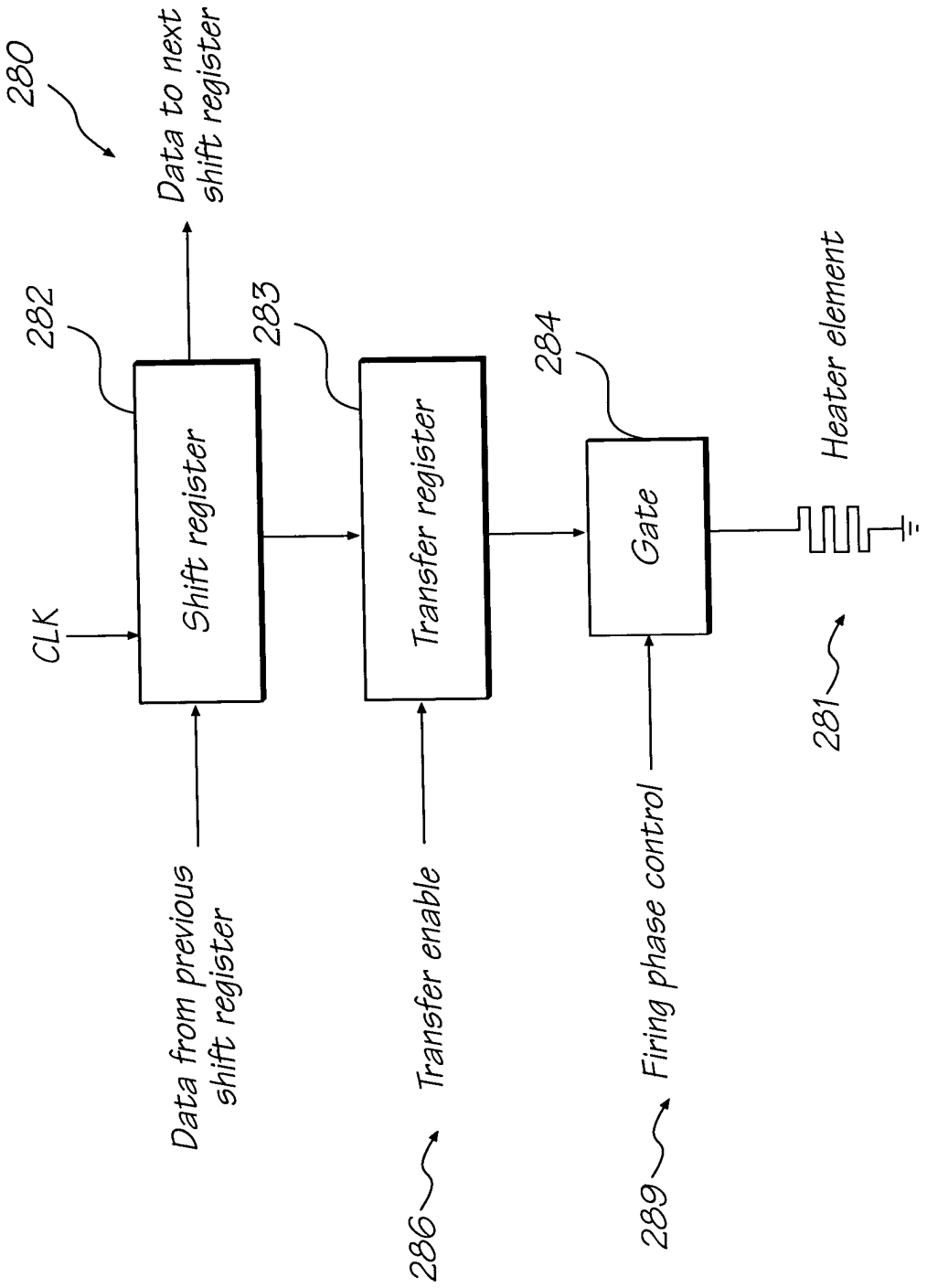

280
Data to next shift register
282
283
284
Shift register
Transfer register
Gate
Heater element
CLK
Data from previous shift register
Transfer enable
Firing phase control
286
289
281

FIG. 76

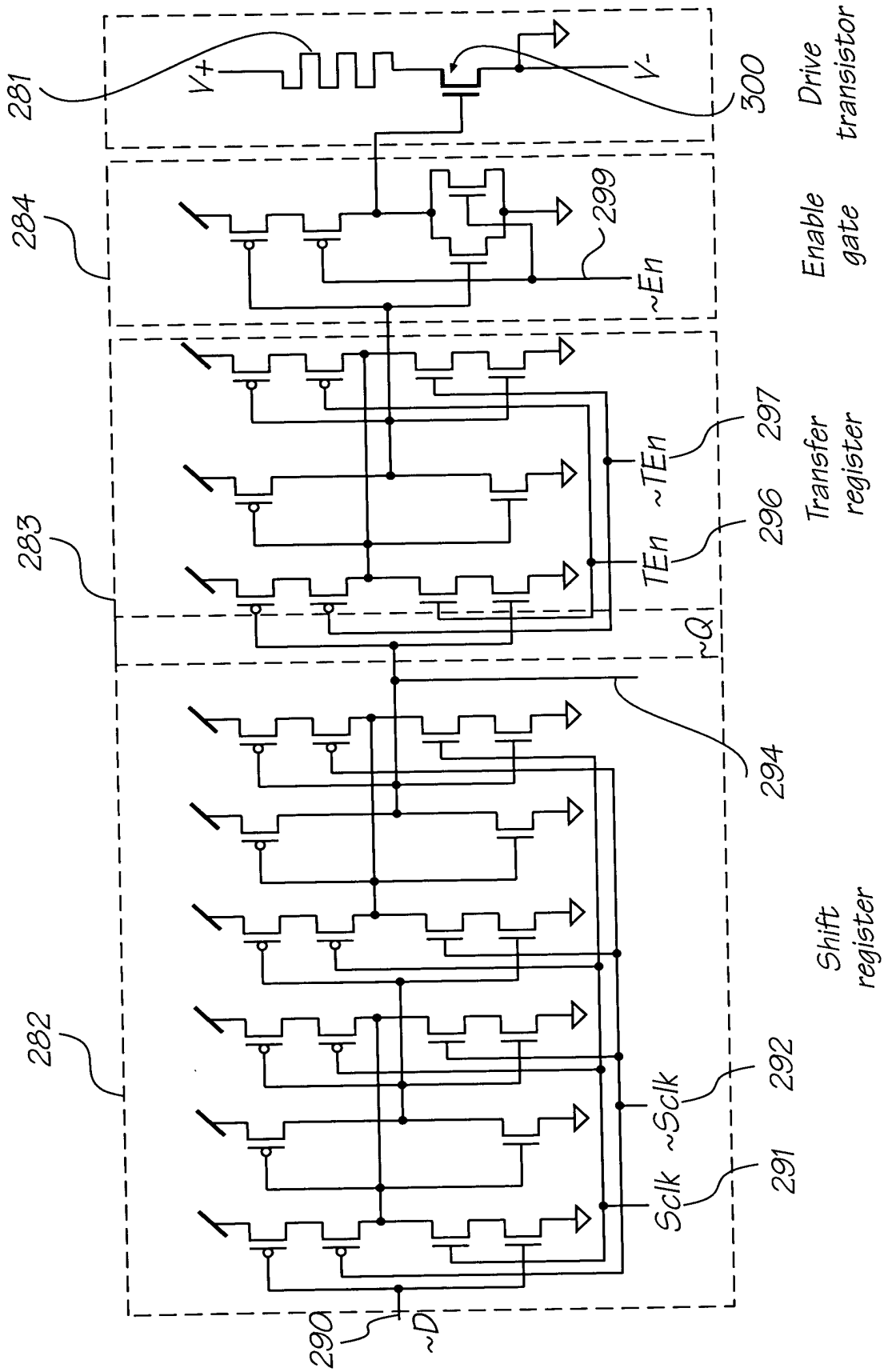

281
V+
V-
300
Drive transistor
284
299
~En
Enable gate
283
297
~TEn
296
TEn
Transfer register
~Q
294
282
292
~Sclk
291
Sclk
Shift register
290
~D

FIG. 77

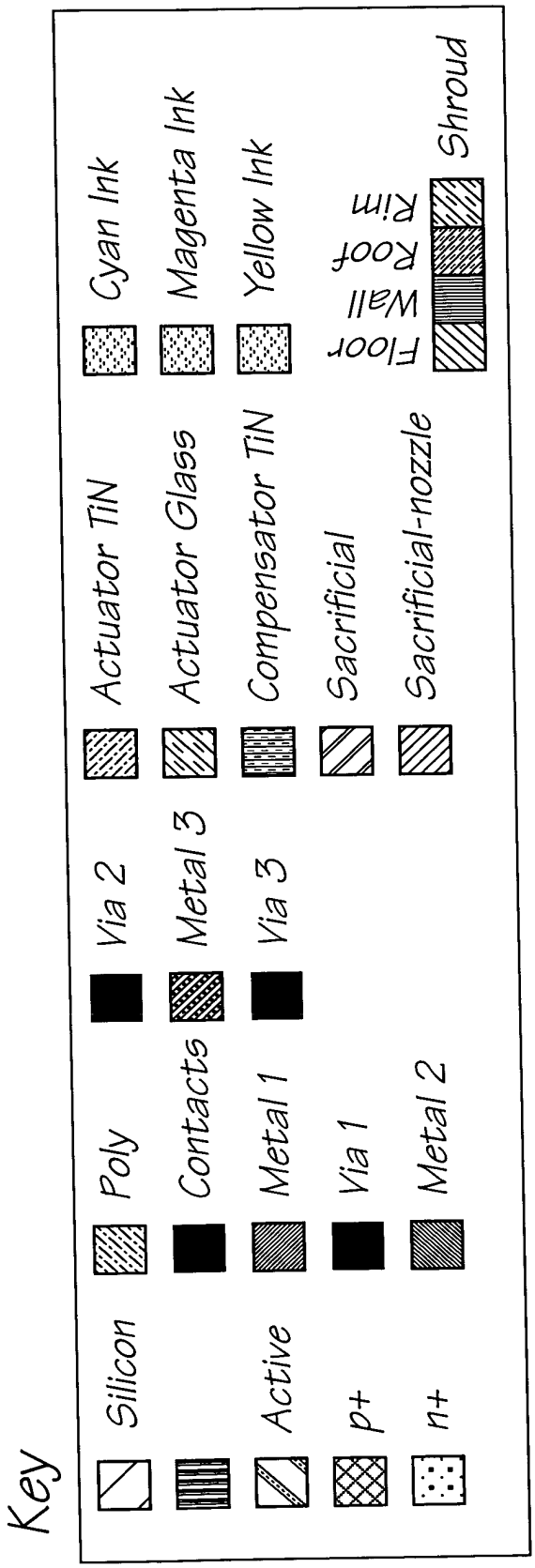

Key
Silicon
Poly
Via 2
Actuator TiN
Cyan Ink
Contacts
Metal 3
Actuator Glass
Magenta Ink
Active
Metal 1
Via 3
Compensator TiN
Yellow Ink
p+
Via 1
Sacrificial
Floor
Wall
Roof
Rim
n+
Metal 2
Sacrificial-nozzle
Shroud

FIG. 78

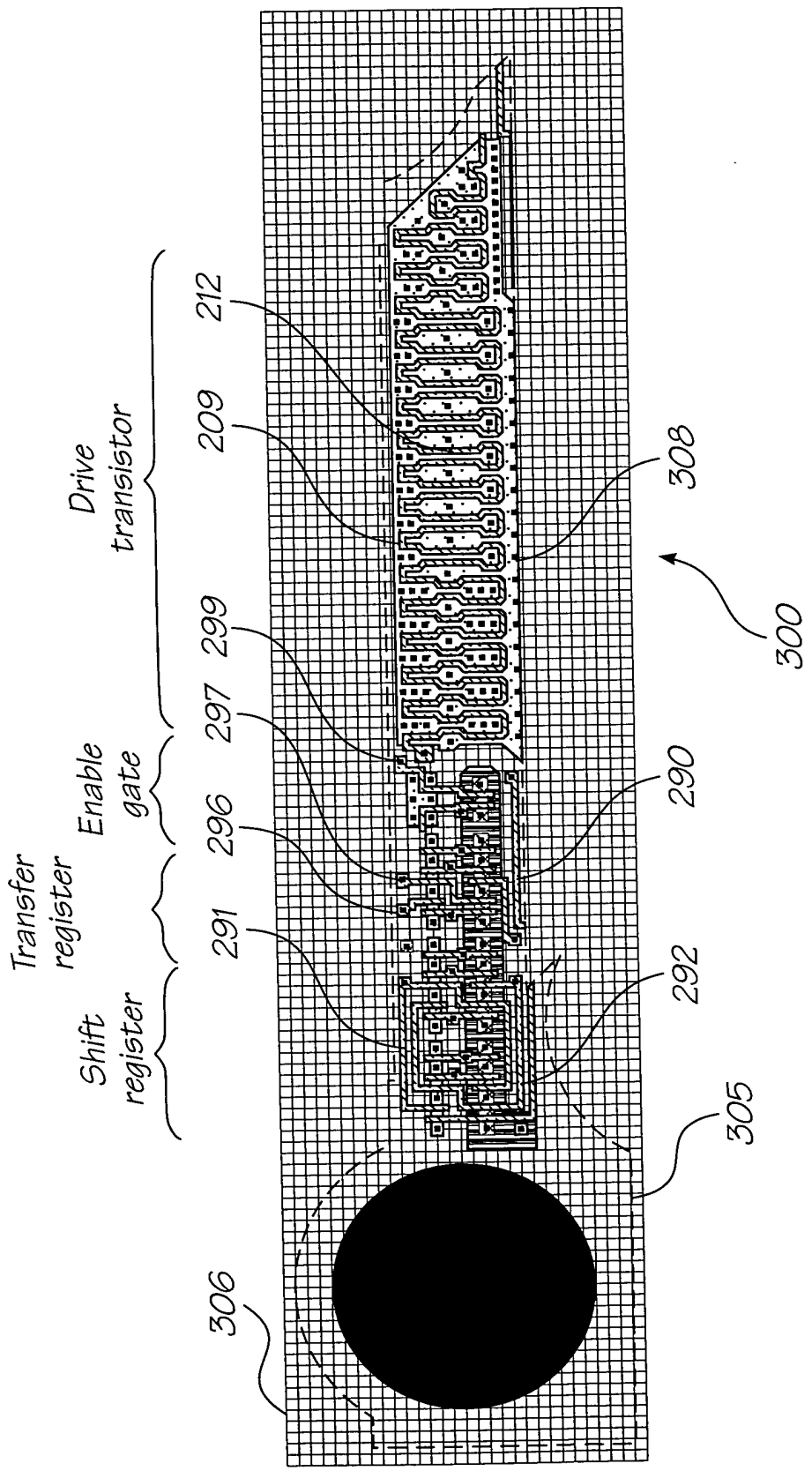

Drive transistor
Enable gate
Transfer register
Shift register
212
209
308
299
297
296
290
291
292
305
306
300

FIG. 79

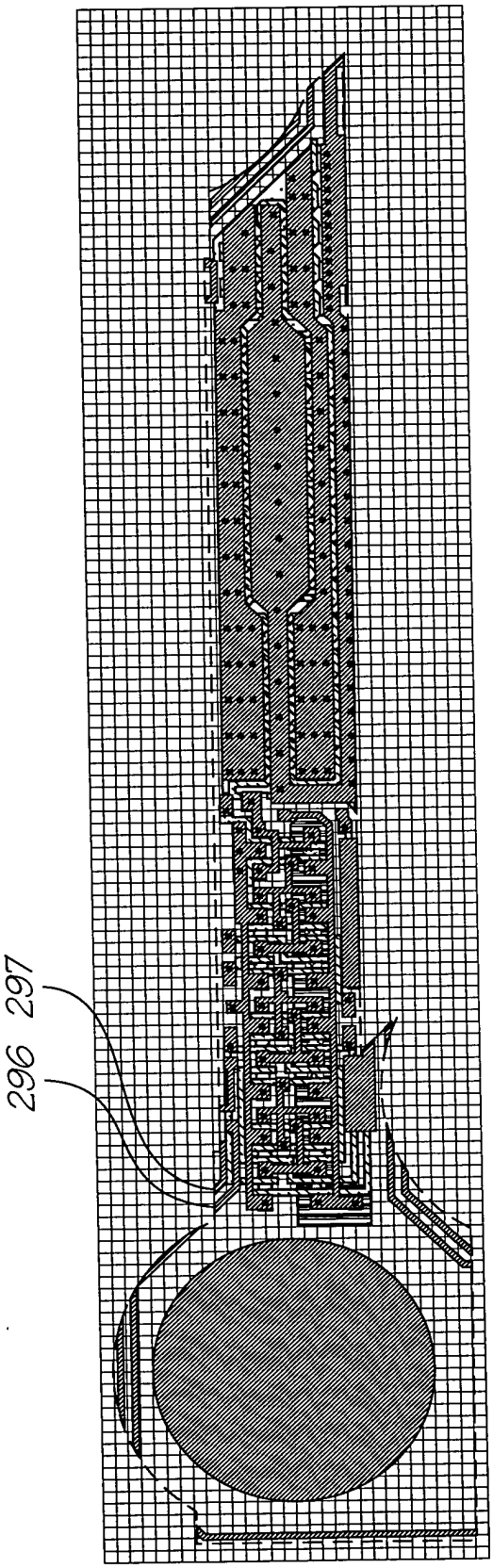


FIG. 80

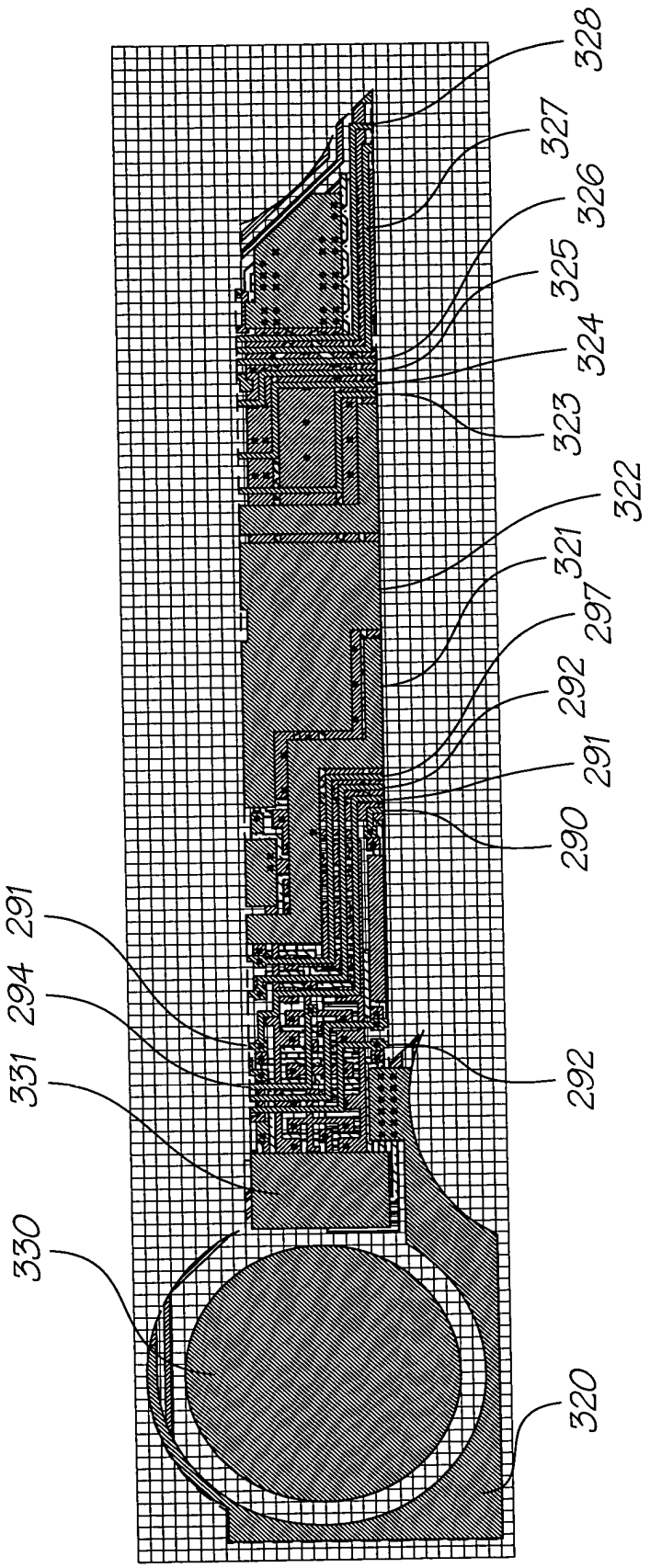

328
327
326
325
324
323
322
321
297
292
291
290
291
294
331
330
292
320

FIG. 81

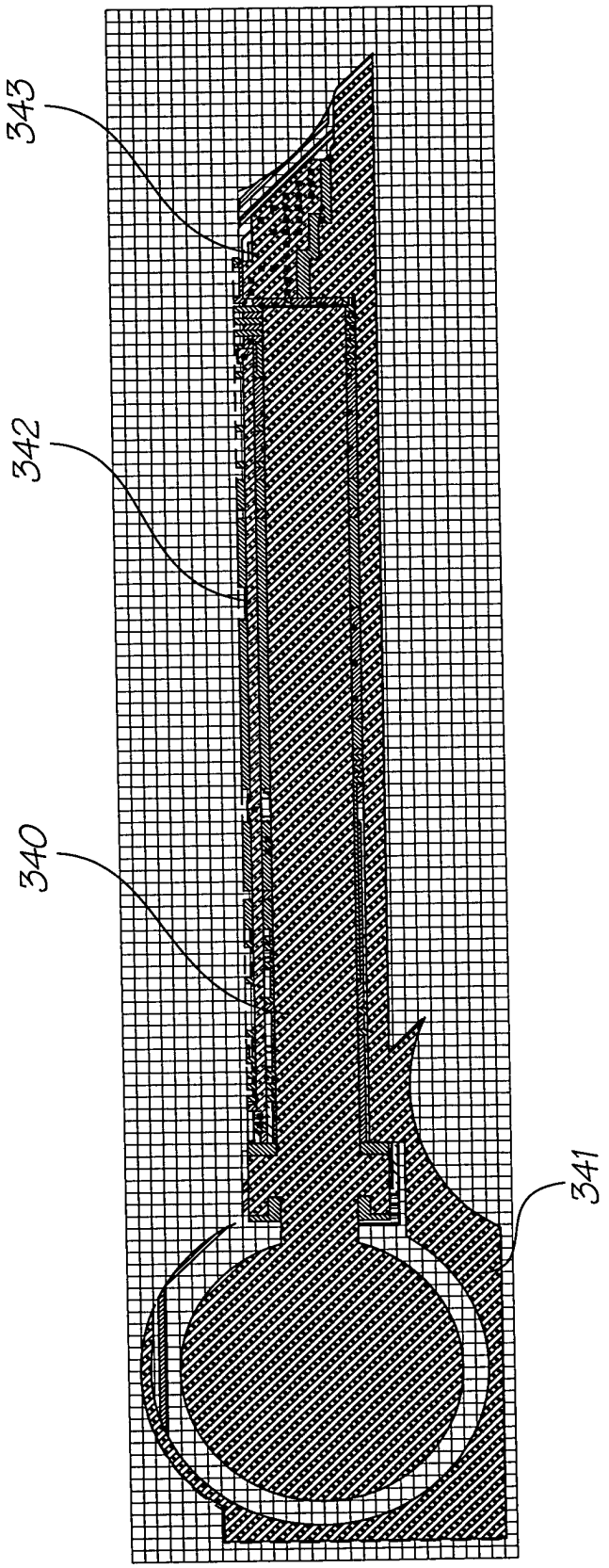


FIG. 82

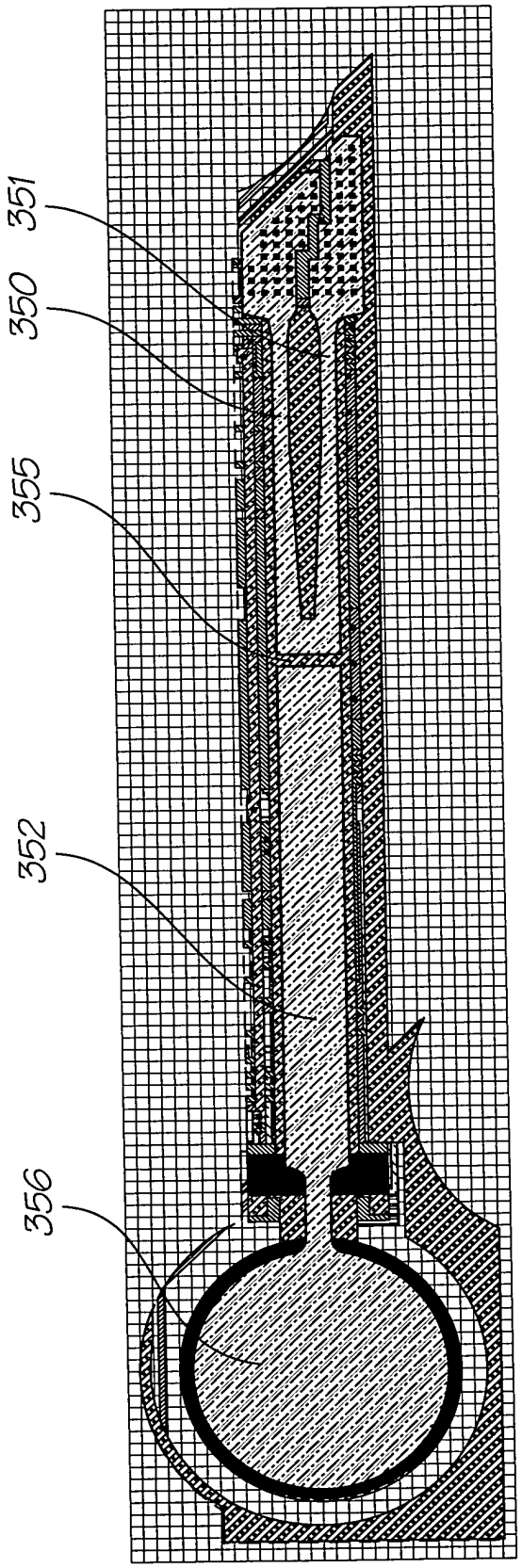


FIG. 83

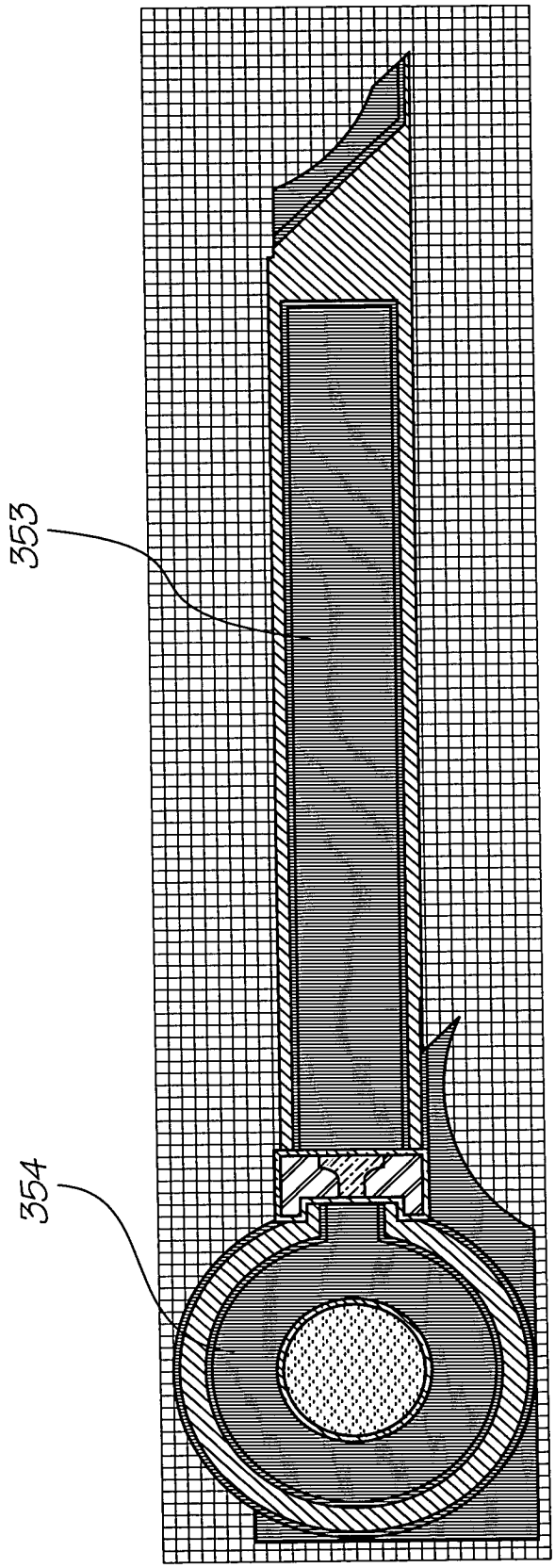


FIG. 84

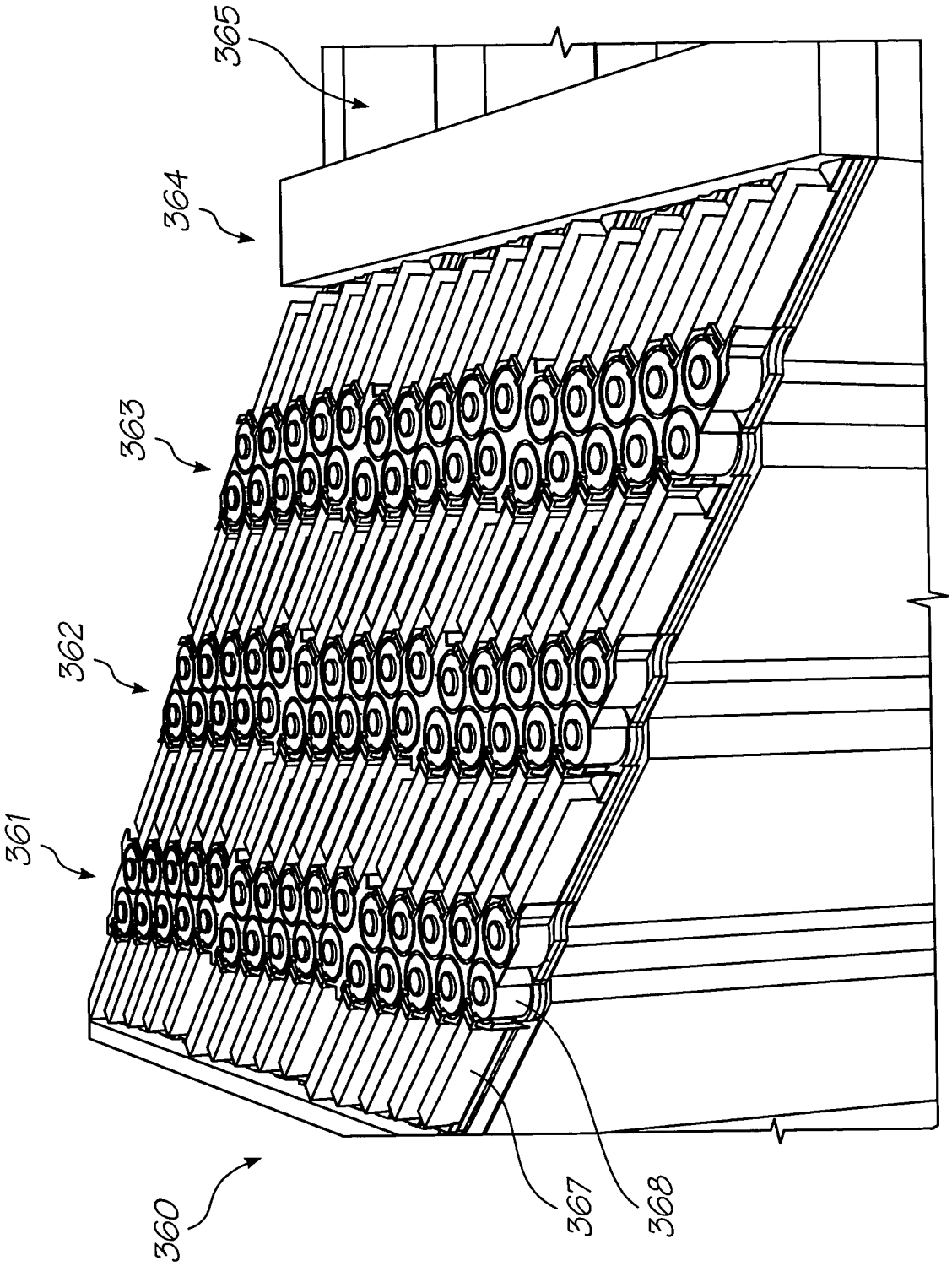


FIG. 85

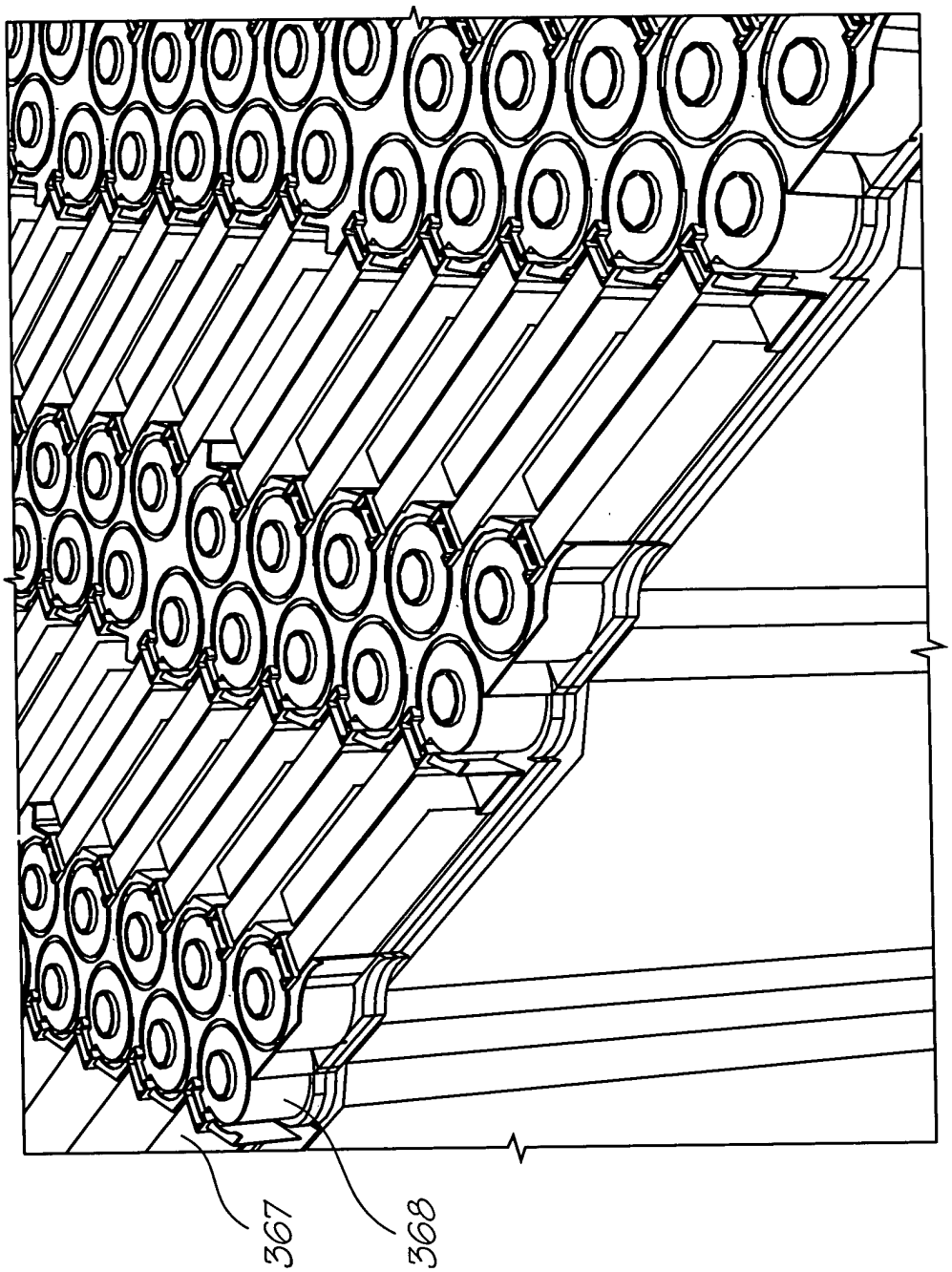


FIG. 86

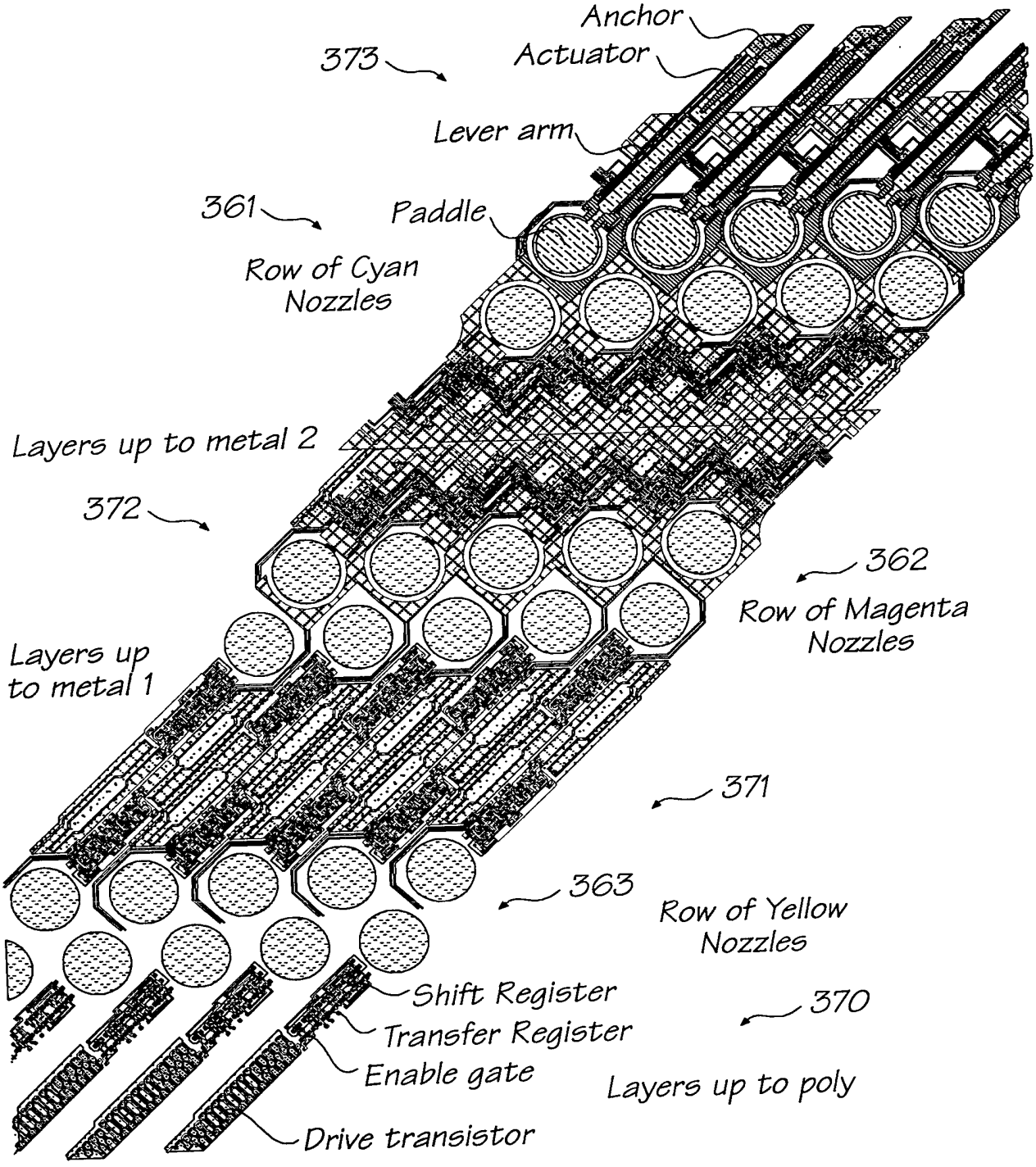

Anchor
373
Actuator
Lever arm
361
Paddle
Row of Cyan Nozzles
Layers up to metal 2
372
362
Row of Magenta Nozzles
Layers up to metal 1
371
363
Row of Yellow Nozzles
Shift Register
370
Transfer Register
Enable gate
Layers up to poly
Drive transistor

FIG. 87

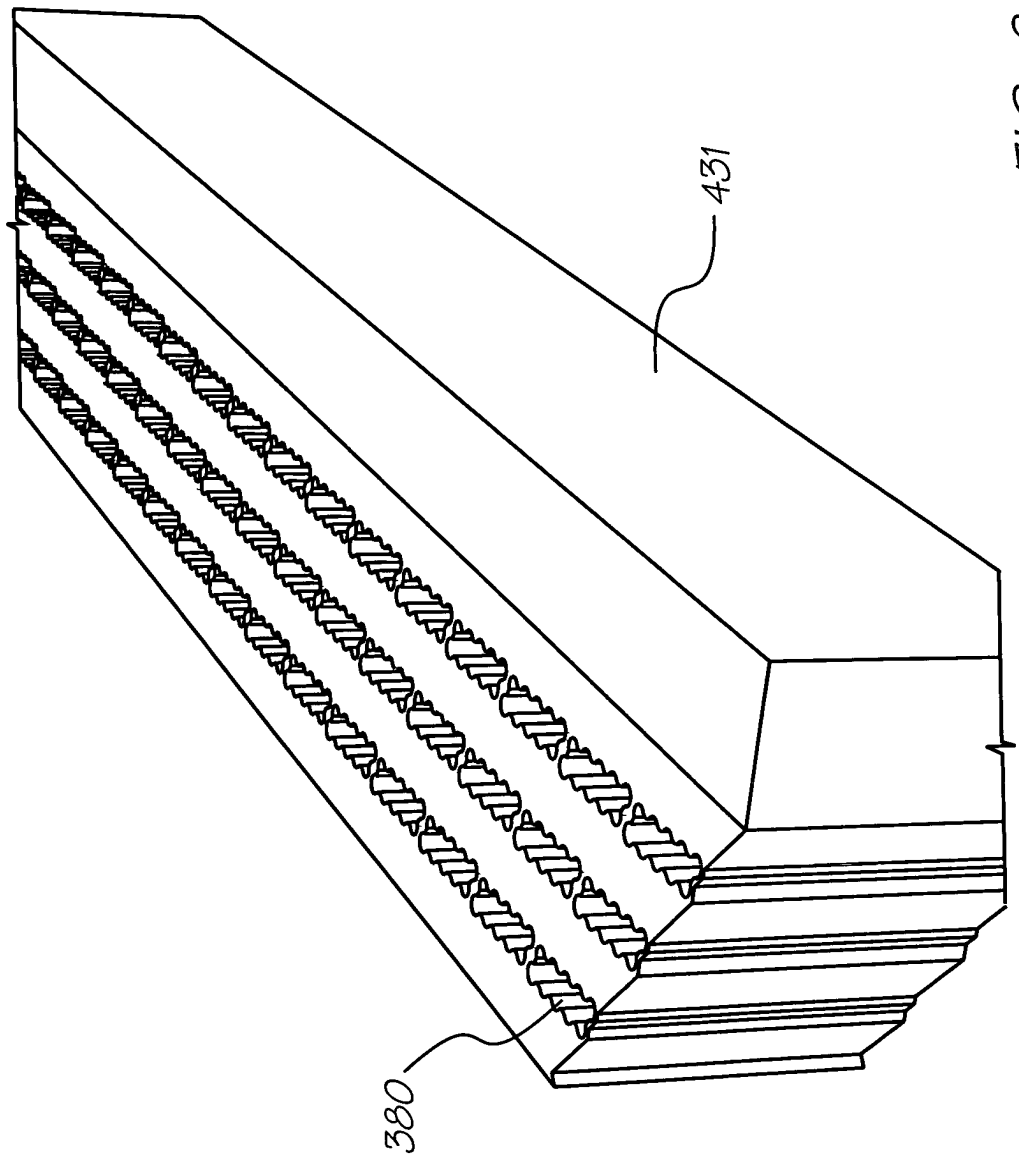


FIG. 88

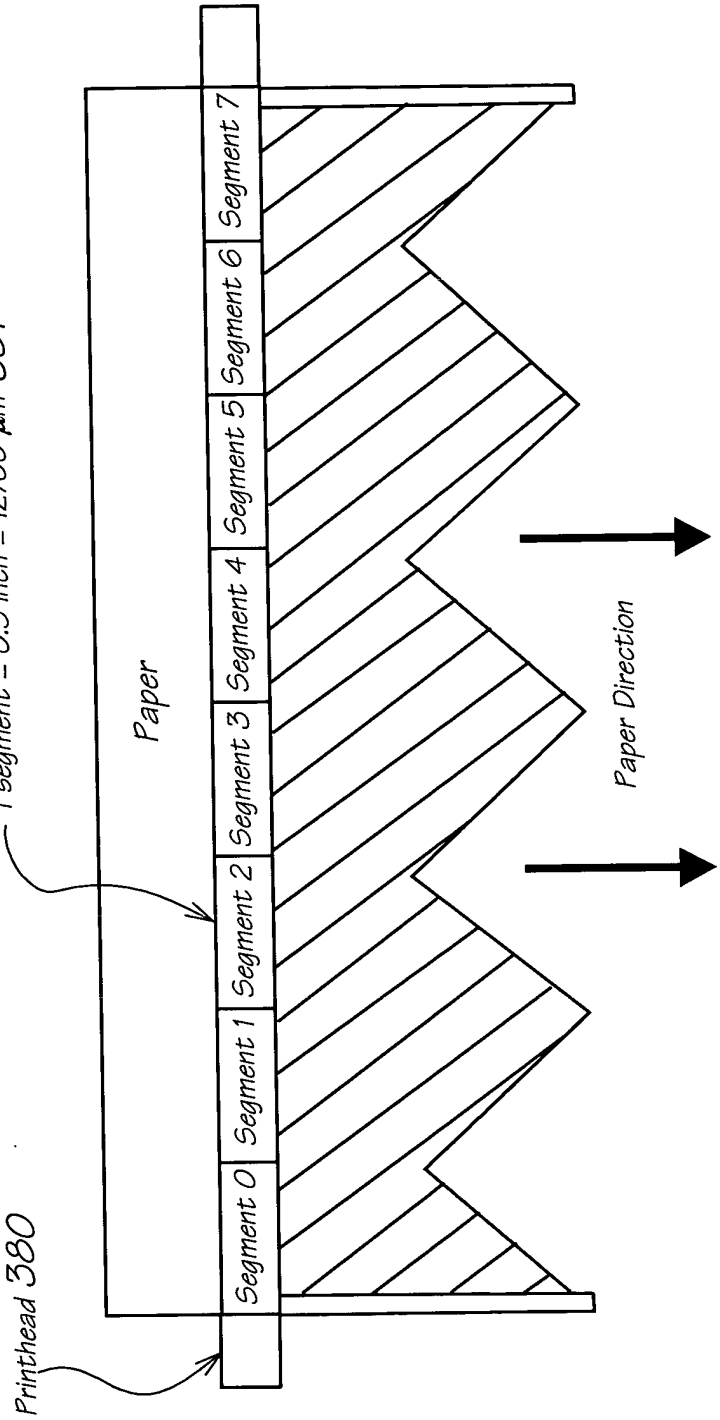
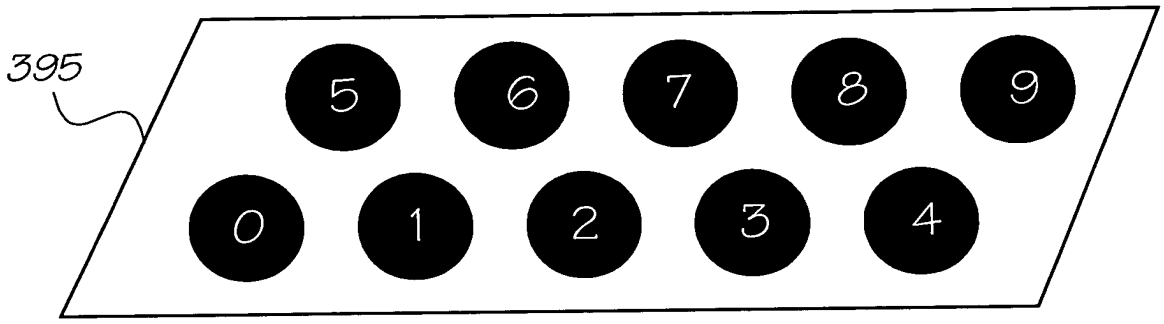

Printhead 380
1 segment = 0.5 inch = 12700 µm 381
Paper
Segment 0
Segment 1
Segment 2
Segment 3
Segment 4
Segment 5
Segment 6
Segment 7
Paper Direction

FIG. 89



A single pod, numbered by firing order

FIG. 90

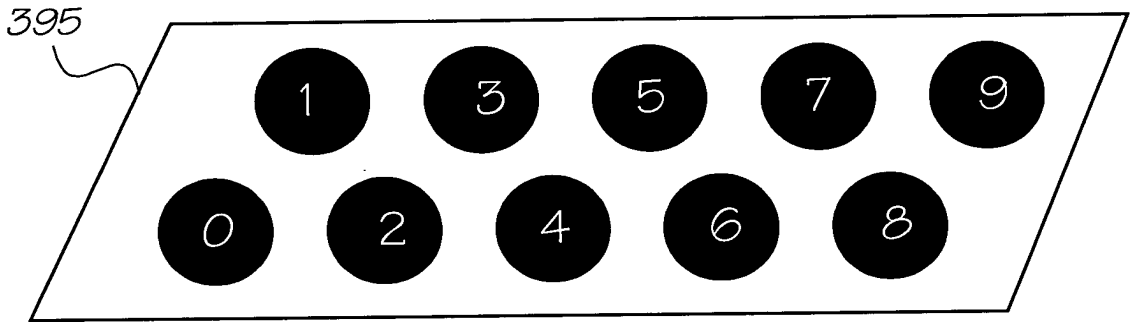


FIG. 91

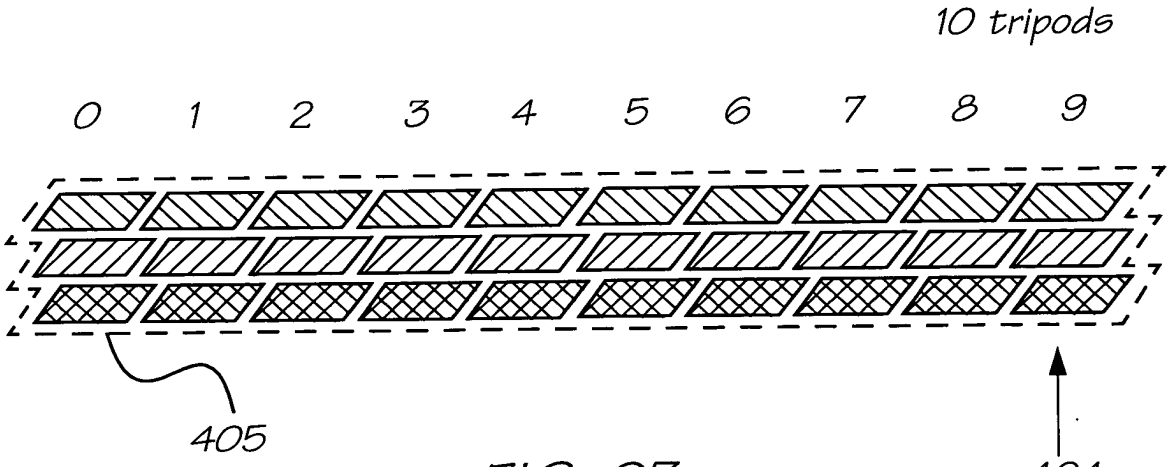


FIG. 93

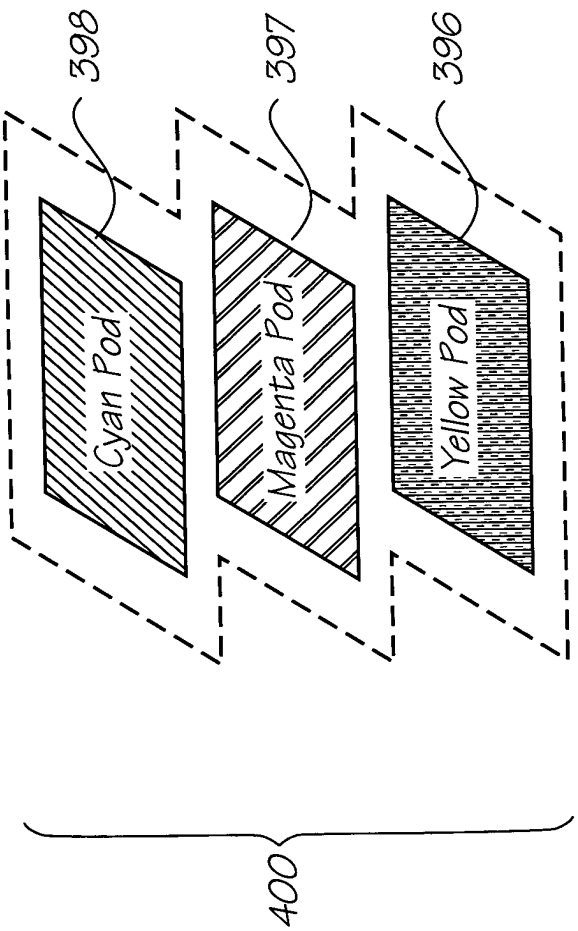


FIG. 92

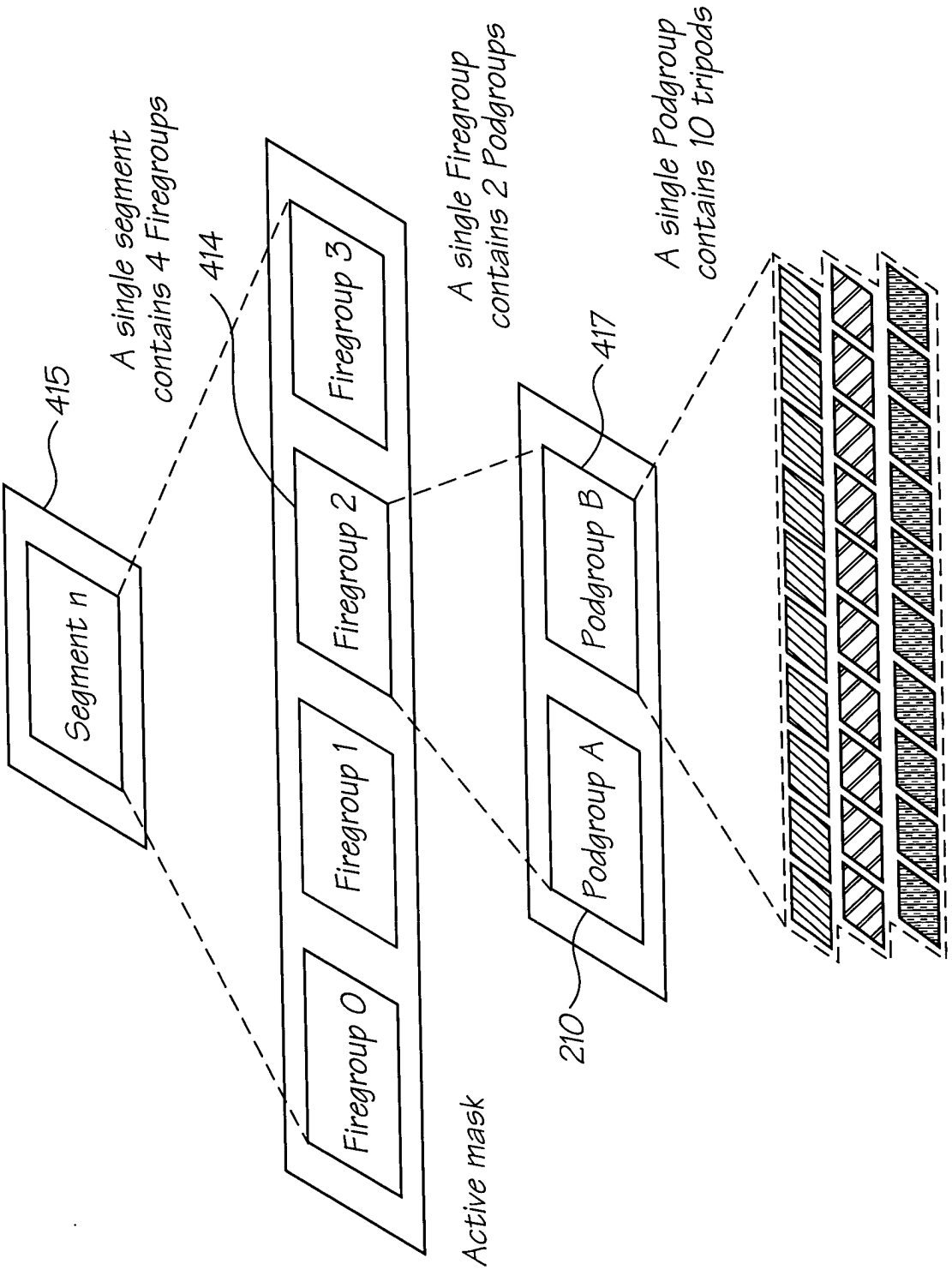

Segment n
415
A single segment
contains 4 Firegroups
414
Firegroup 0
Firegroup 1
Firegroup 2
Firegroup 3
Active mask
A single Firegroup
contains 2 Podgroups
417
Podgroup A
Podgroup B
210
A single Podgroup
contains 10 tripods

FIG. 94

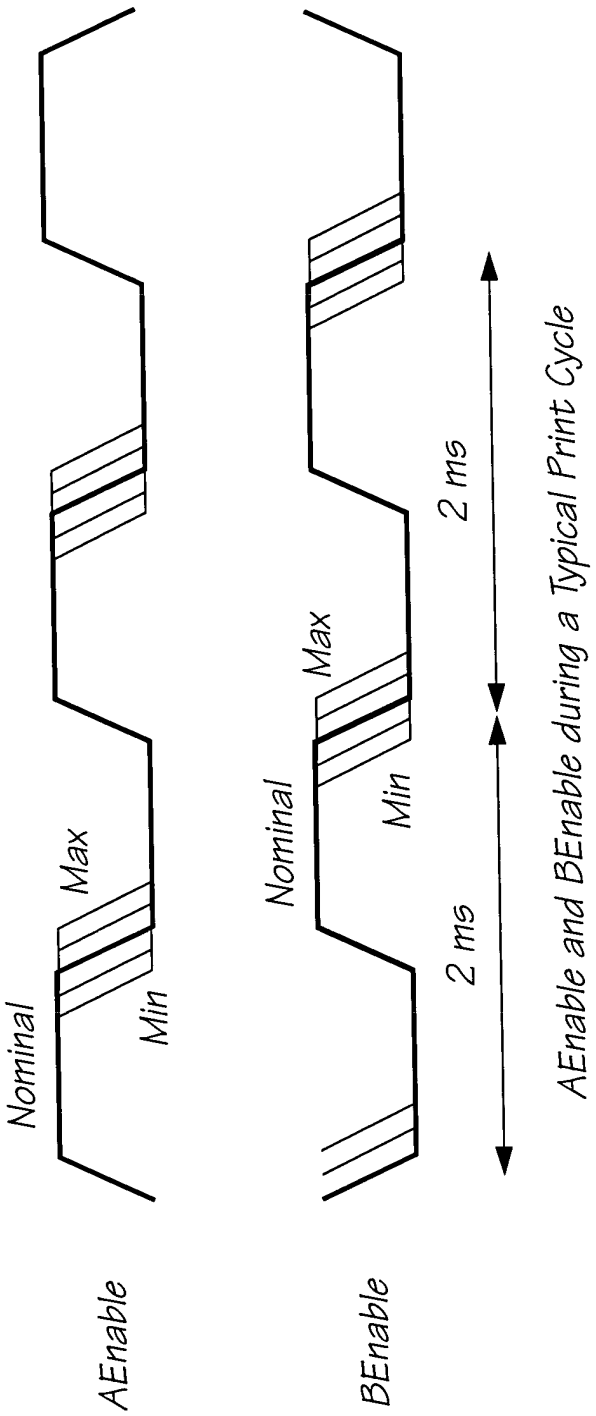

AEnable
Nominal
Max
Min
BEnable
Nominal
Max
Min
2 ms
2 ms
AEnable and BEnable during a Typical Print Cycle

FIG. 95

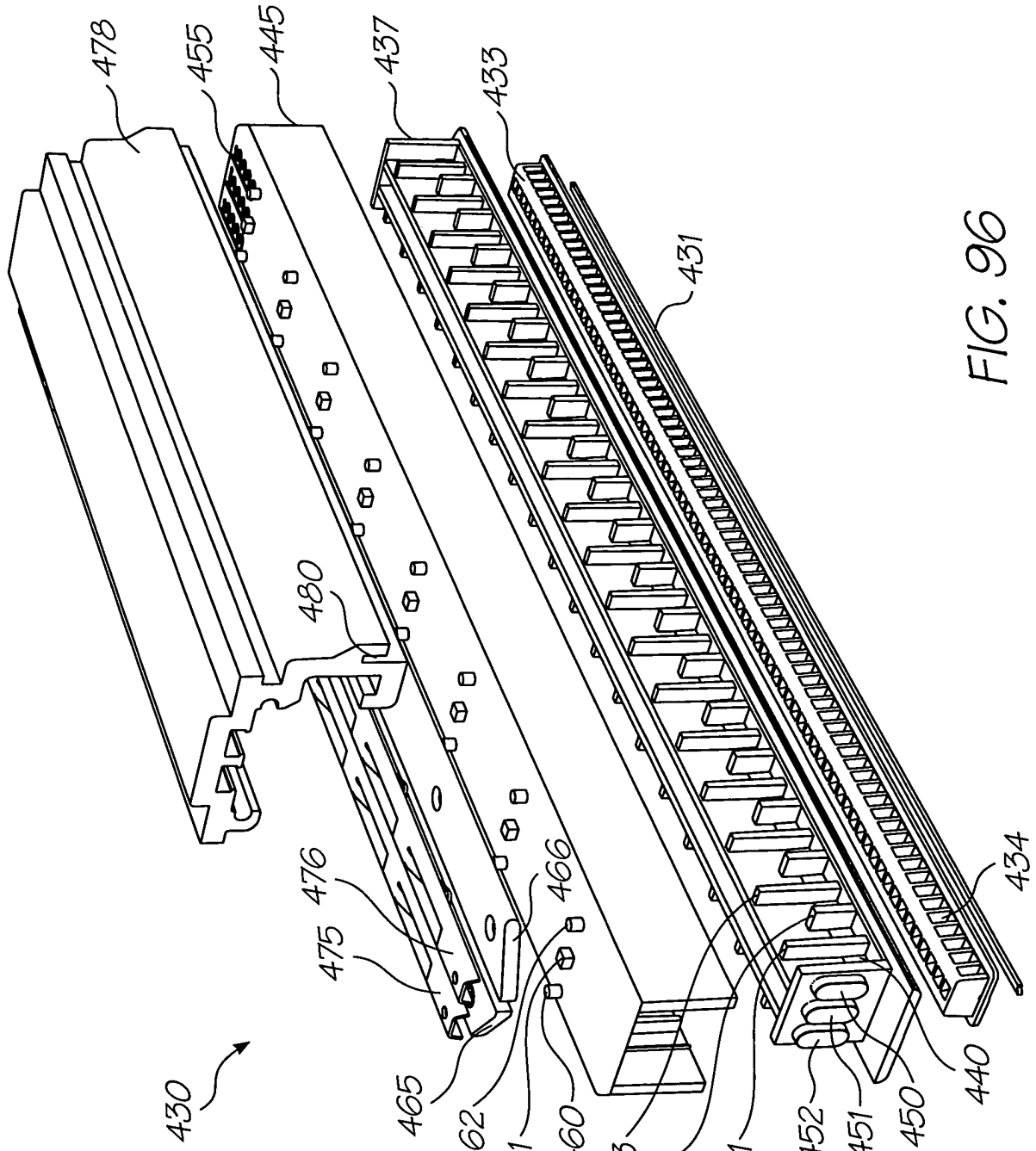

478
455
445
437
433
431
434
480
476
475
466
465
462
461
460
443
442
441
452
451
450
440
430

FIG. 96

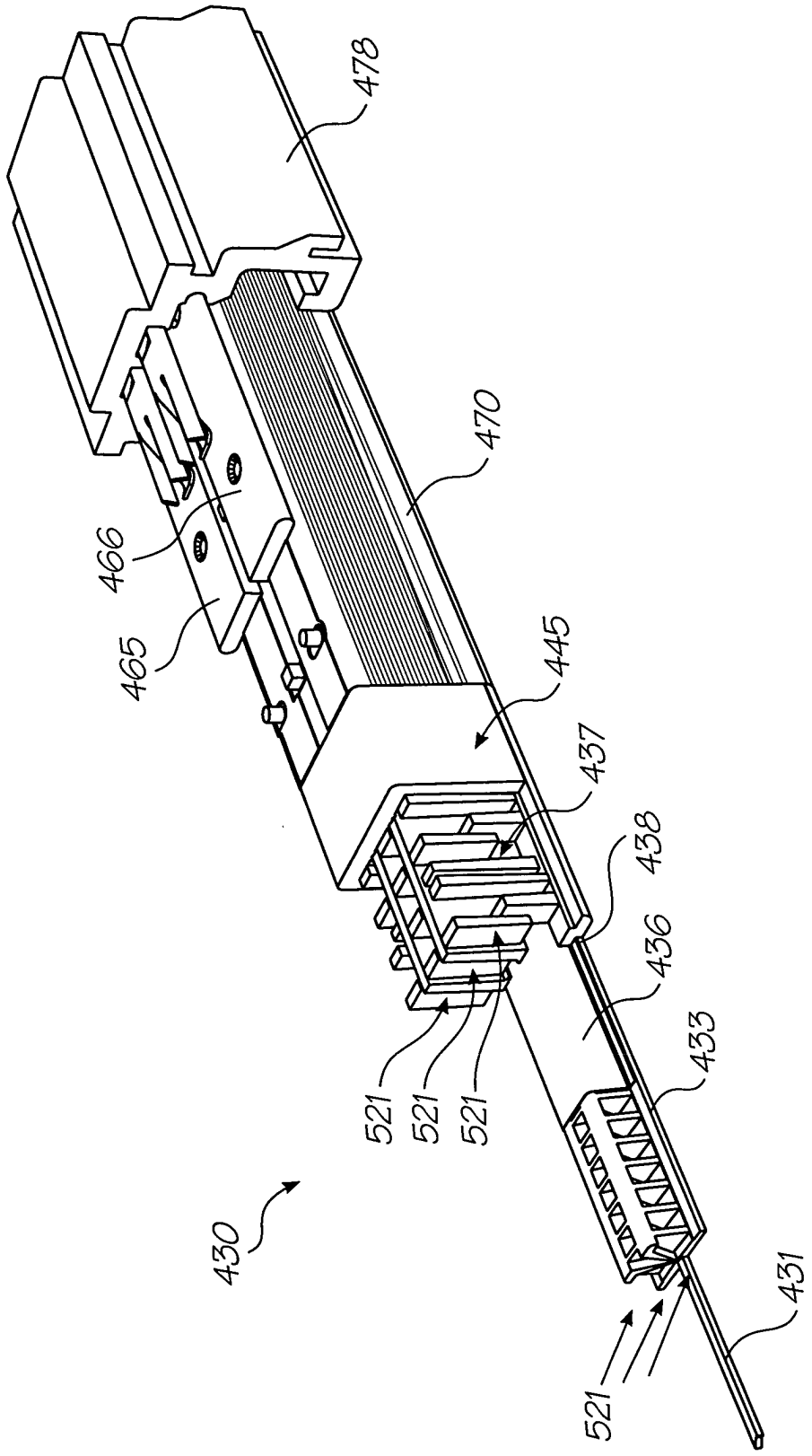


FIG. 97

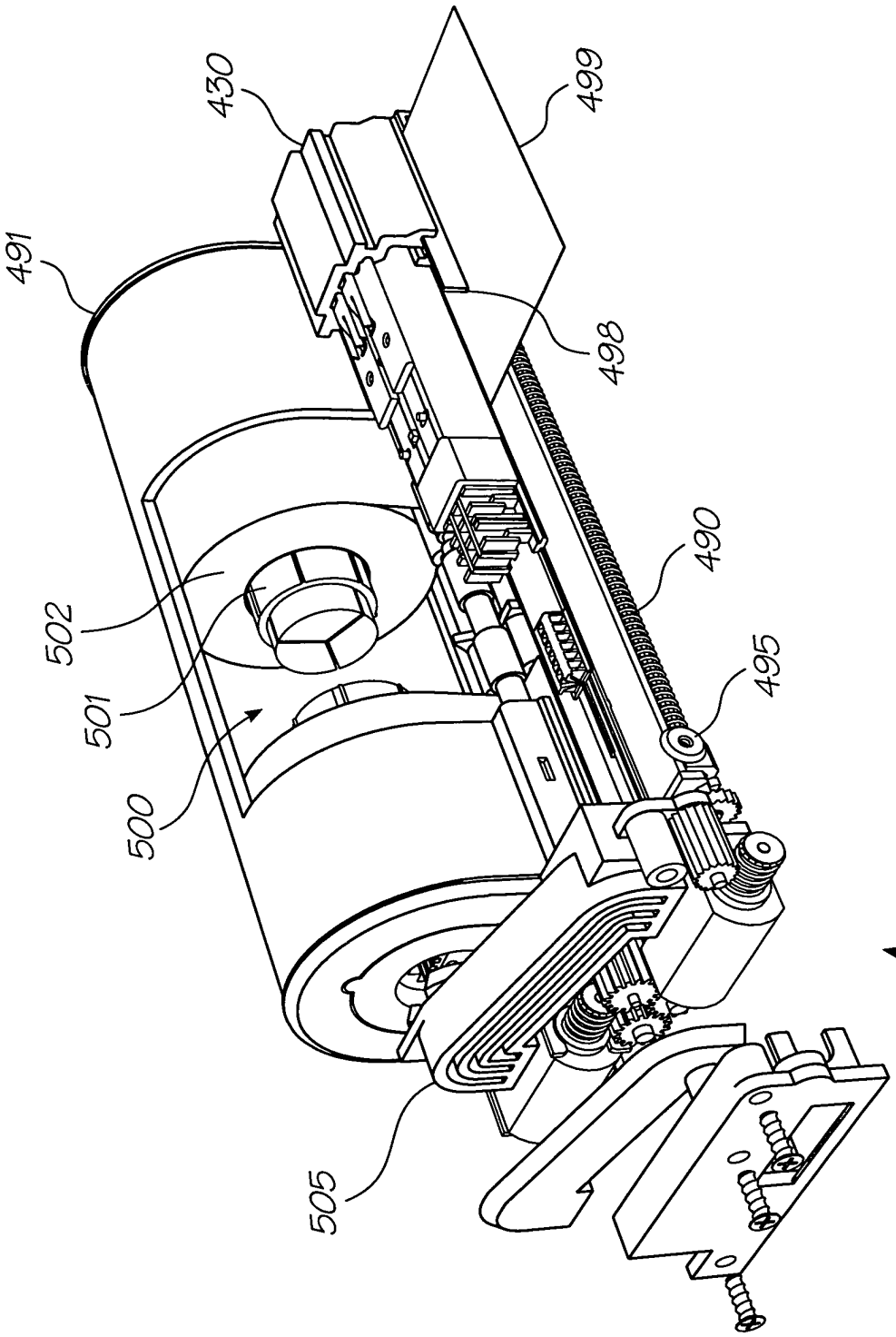


FIG. 98

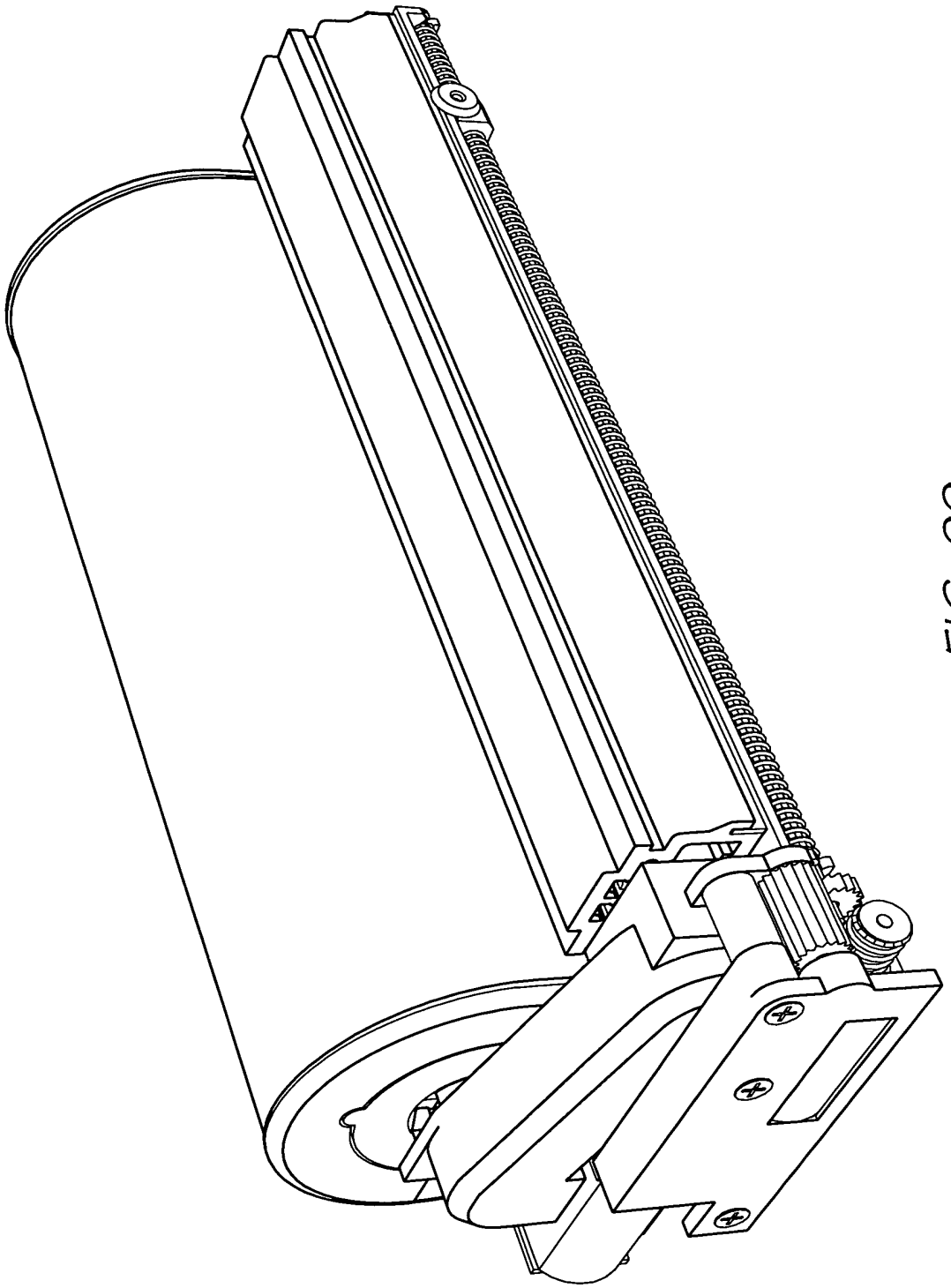


FIG. 99

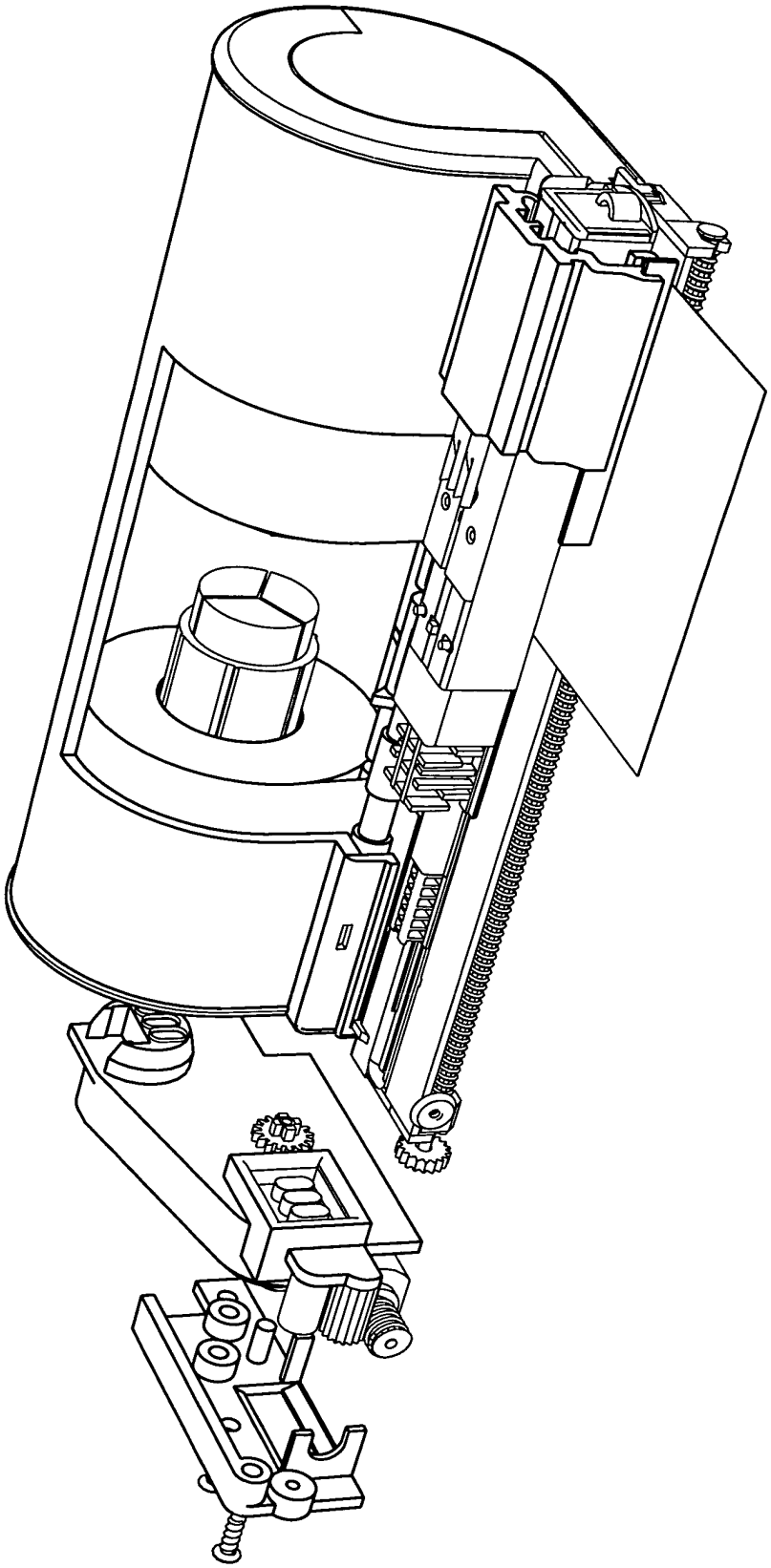


FIG. 100

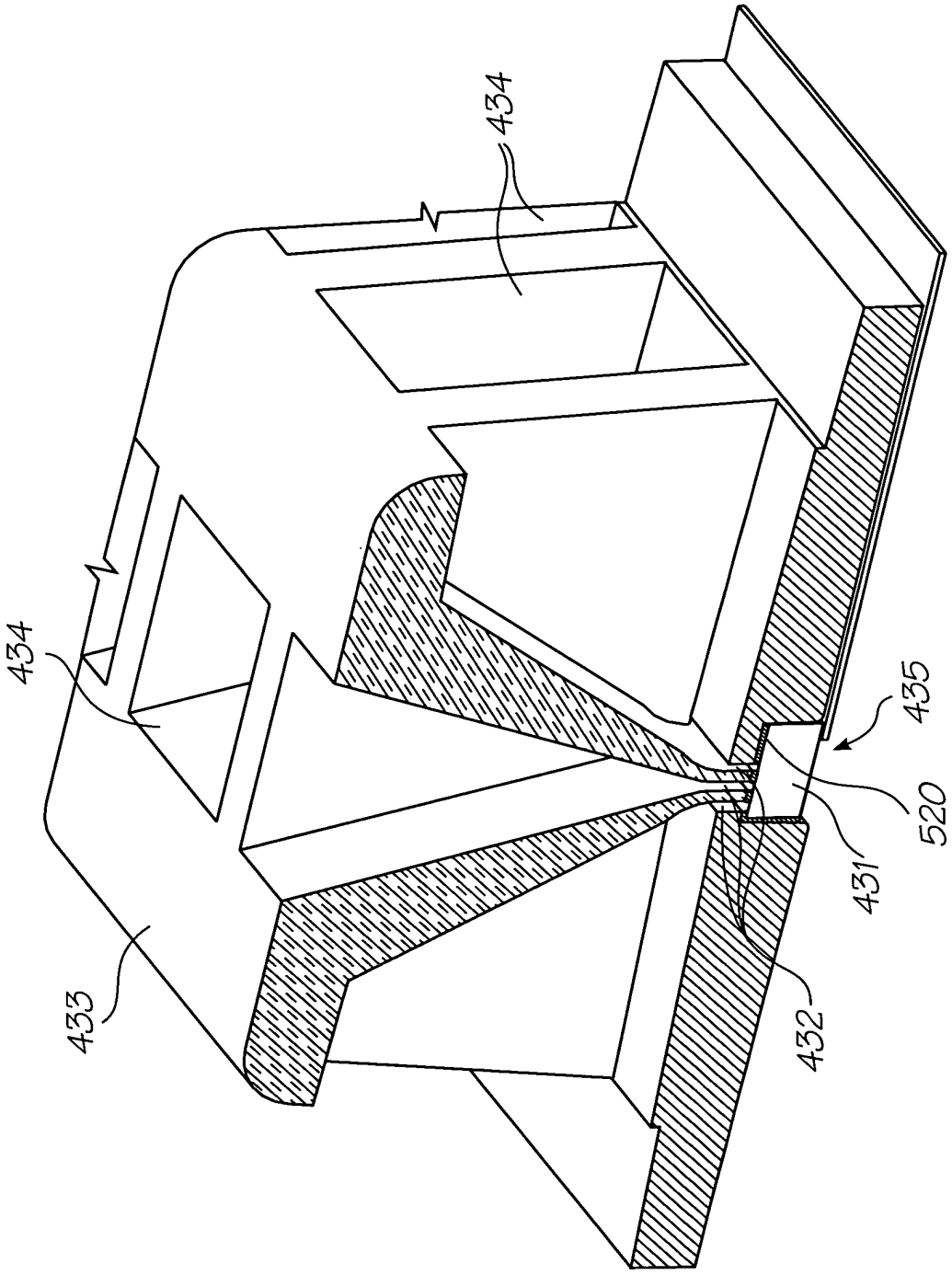


FIG. 101

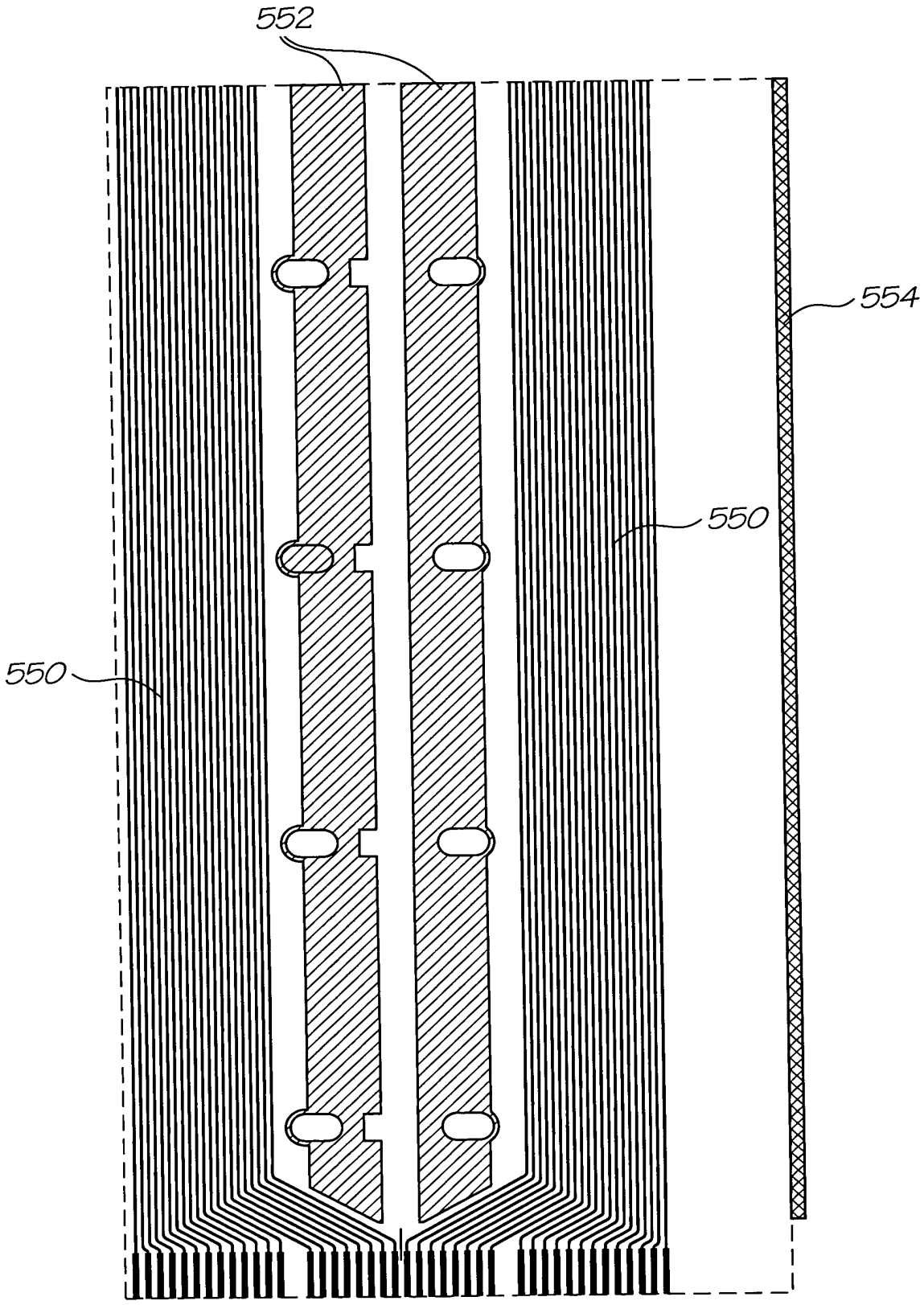


FIG. 102

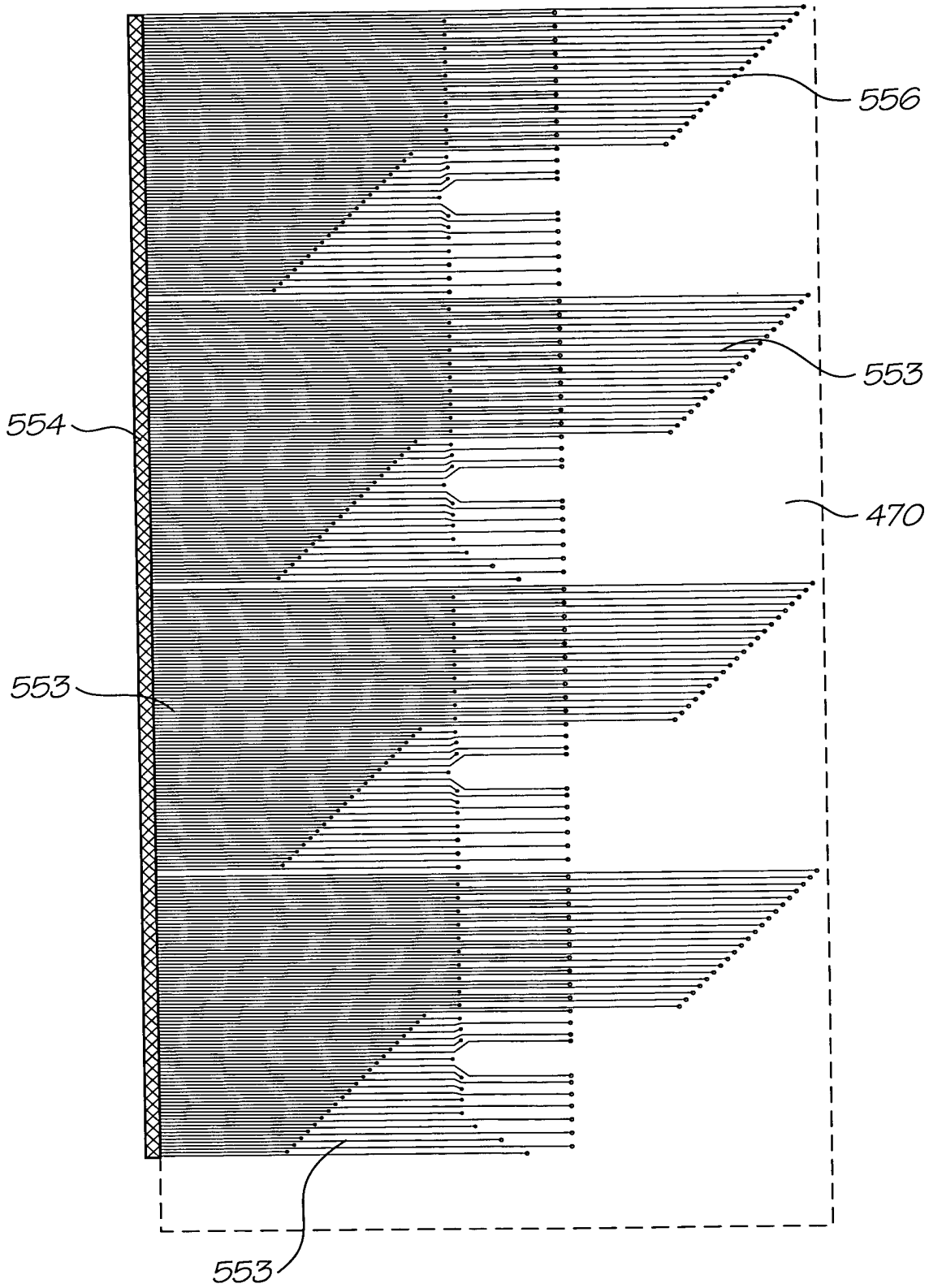


FIG. 103

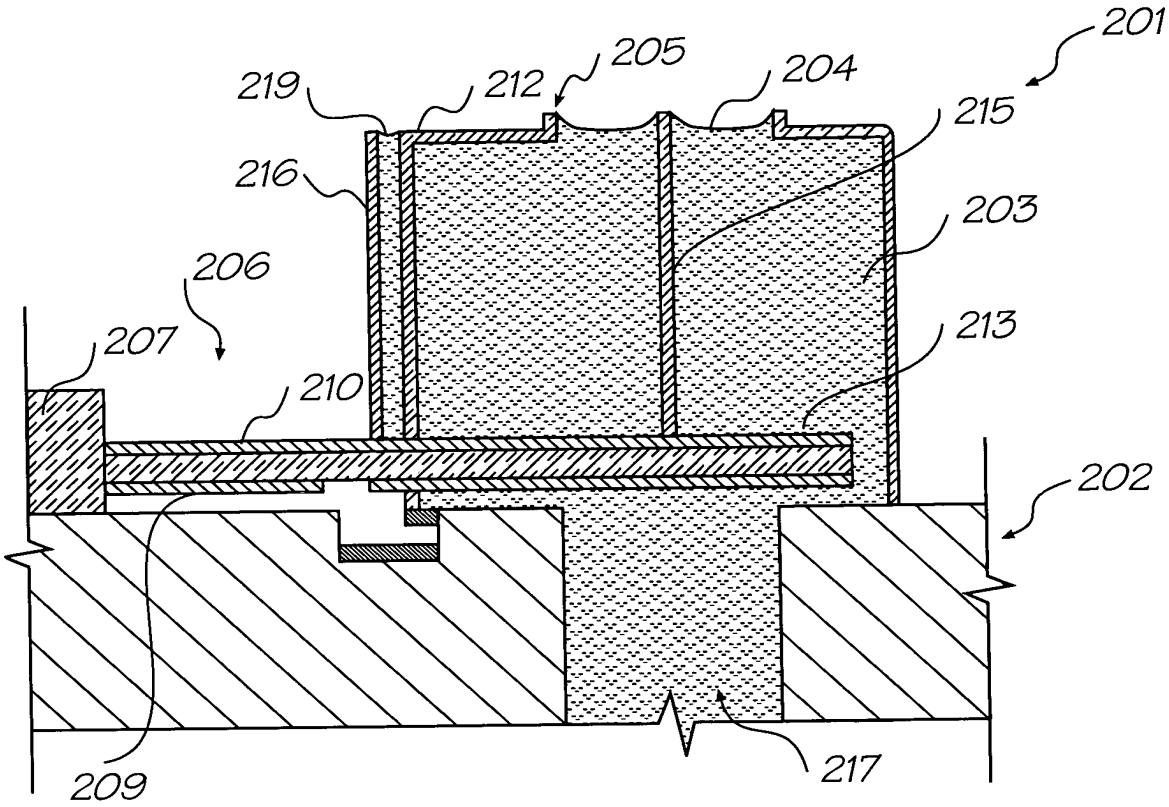


FIG. 104

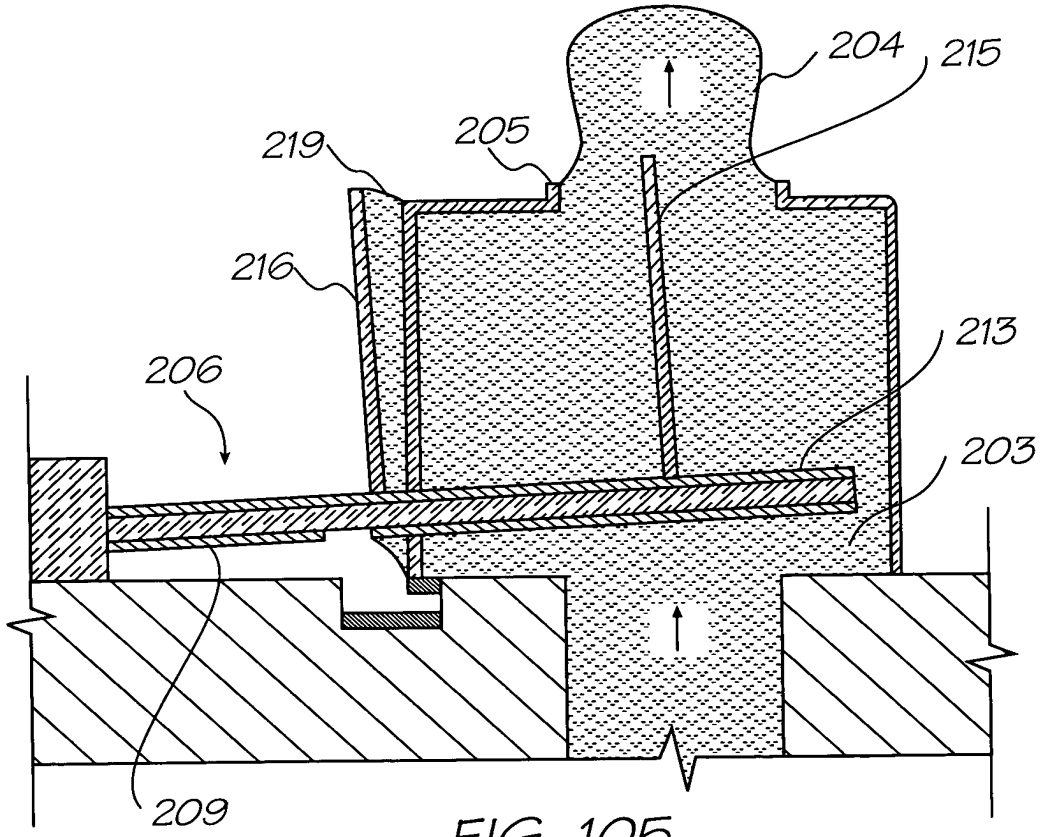


FIG. 105

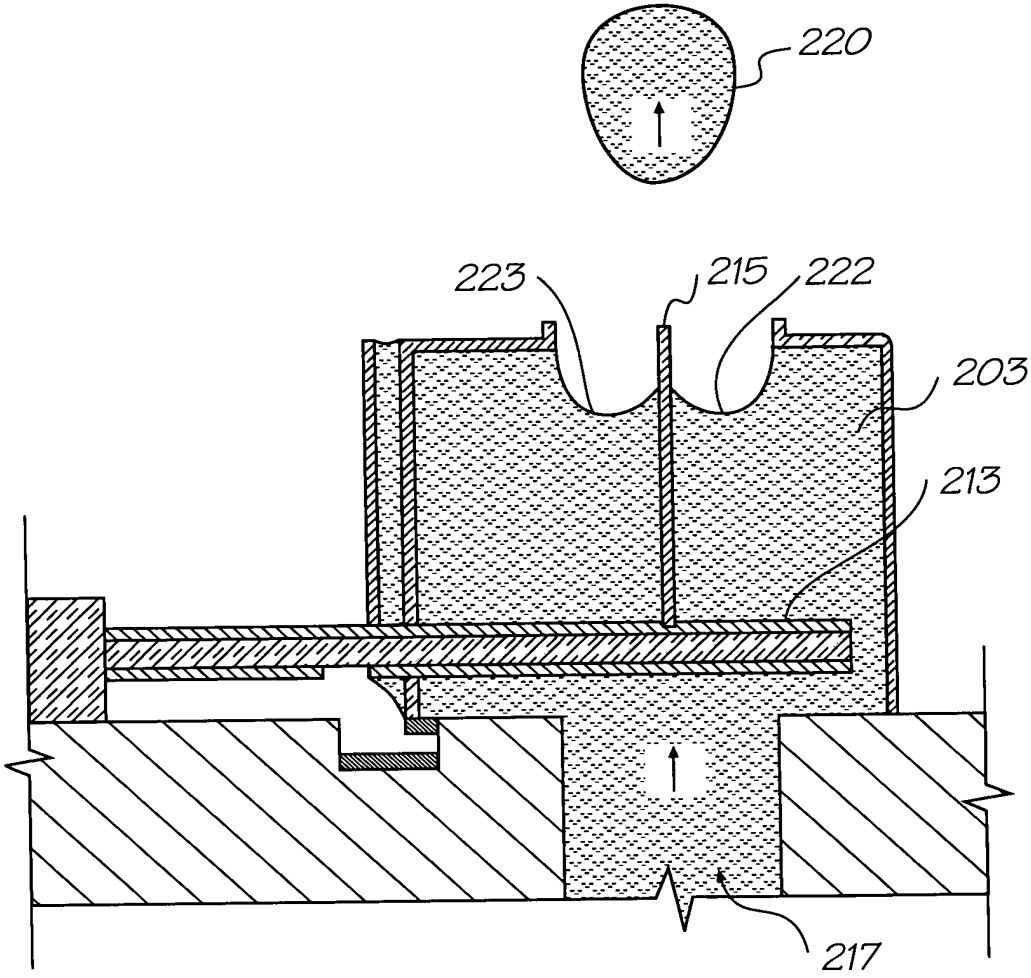


FIG. 106

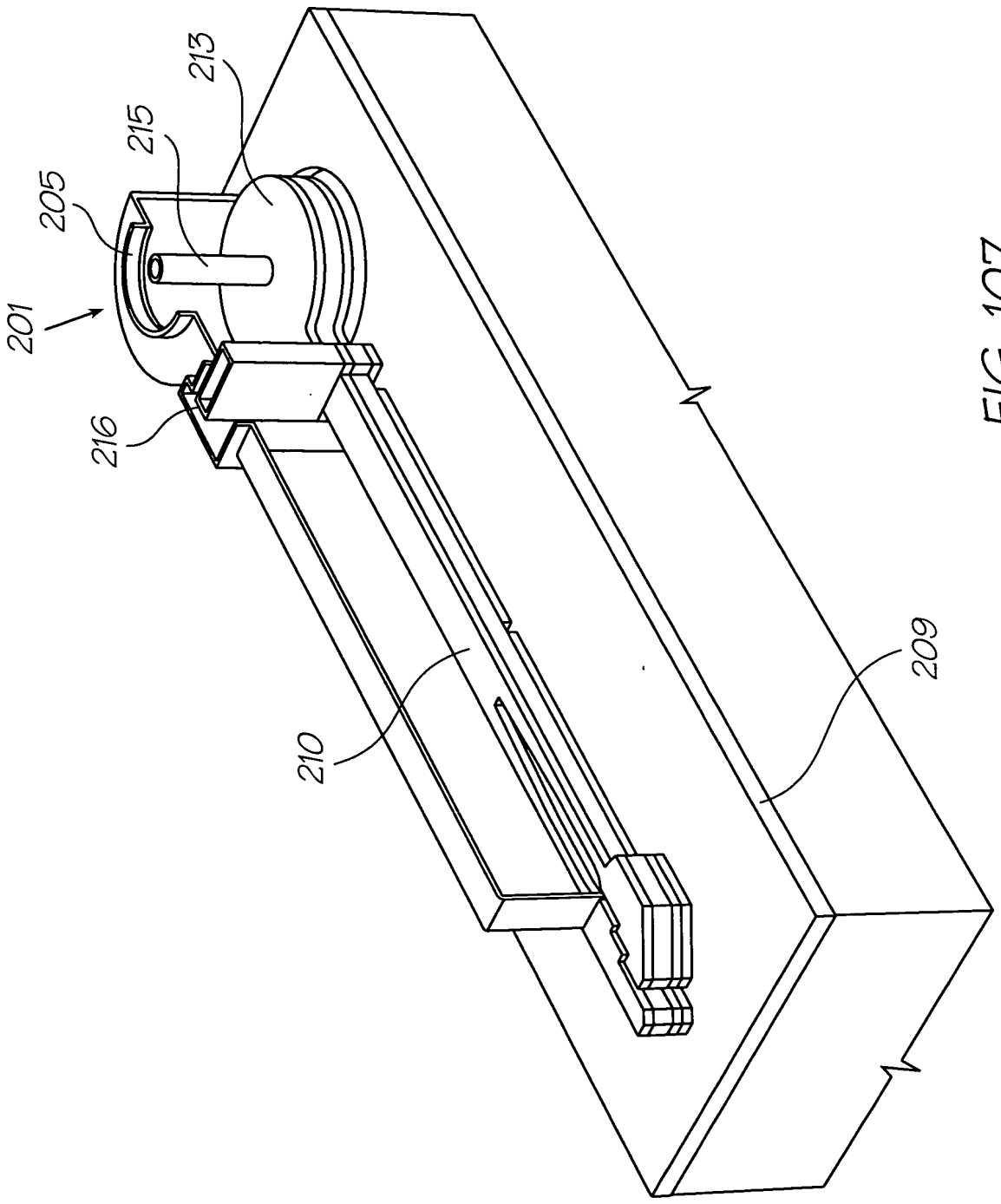


FIG. 107

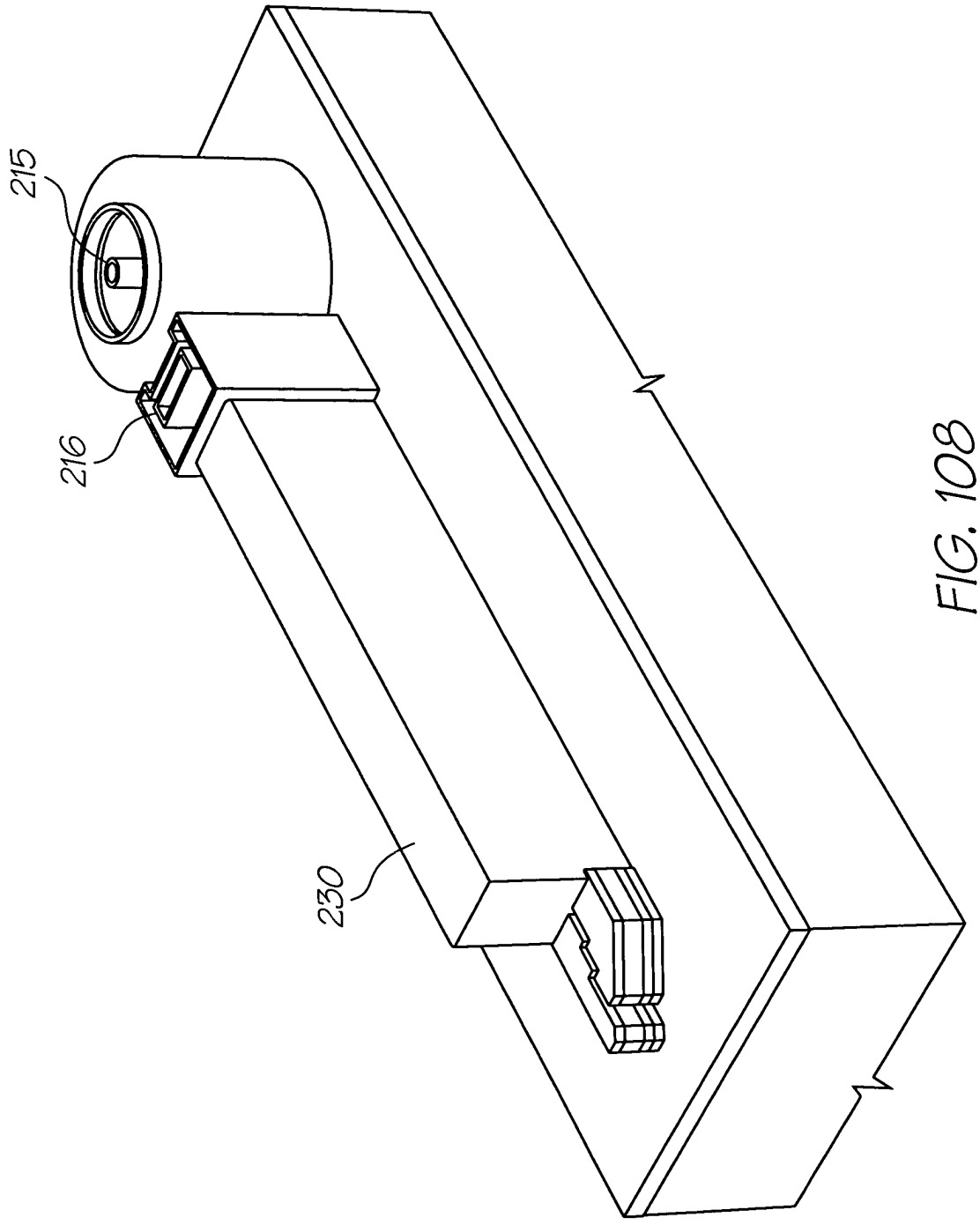


FIG. 108

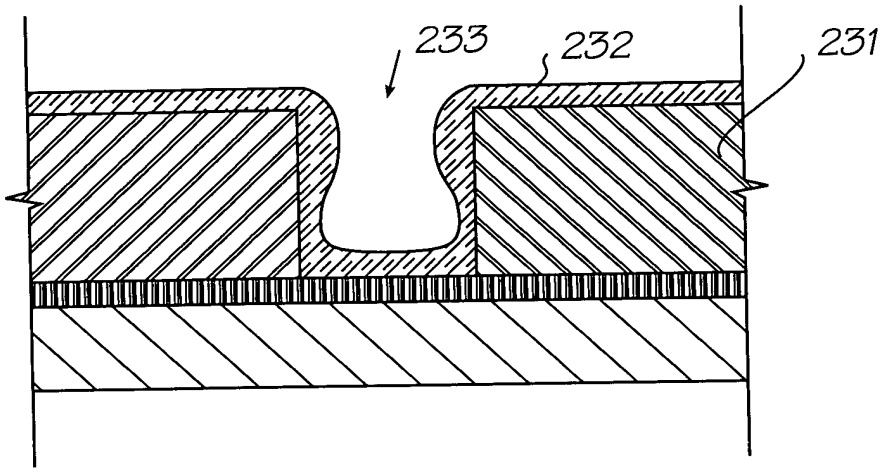


FIG. 109

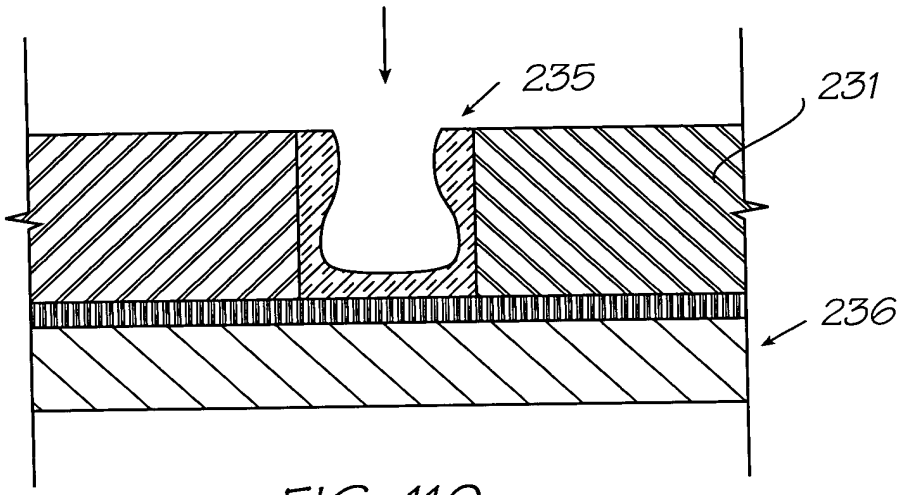


FIG. 110

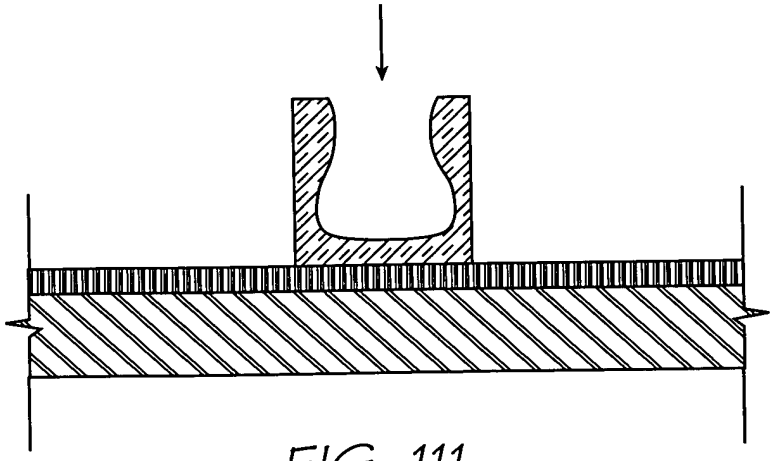


FIG. 111